

2.30.2 Care shall be taken to protect floors, walls, and equipment when paint is applied. Contractor shall cover equipment and floor and wall areas with drop cloths when requested to do so by PG&E.

2.30.3 Field fabricated details, brackets, and shapes shall be prime coat painted with an approved paint. Slag shall be removed, and rust shall be wire brushed before painting.

2.30.4 Ground cables, bus bars, connectors, terminals, and pads shall not be painted.

2.30.5 After cutting for and prior to the installation of controls and relays, switchboards shall be painted by Contractor as specified by PG&E.

2.31 ANCHORAGE:

2.31.1 Drawings shall indicate embedded steel sections or anchor bolts in foundations for platforms, equipment pads, cabinets, structure hangers, etc. Anchorage of equipment that does not have anchor bolts shall use adhesive anchors, as indicated on Civil Design Standard No. 232800, (Document 2 from Table 1), of the same nominal size as the mounting holes in the equipment base.

2.32 GROUTING

2.32.1 Work comprises of furnishing material mixing, placing, finishing, and curing of grout as required under a CWA or this Contract. Work includes grouting or dry-packing machine bases, baseplates, or embedded material, and grouting or dry-packing conduits into pull box windows.

2.32.2 Composition and Mixing Sand Cement Grout:

2.32.2.1 General: Sand cement grout shall be a mixture of cement, water, sand, and pea gravel where required. The consistency of the grout shall be that which suits the placing conditions. Grout shall be non-shrink type. Grout that is not satisfactory shall be removed and replaced.

2.32.2.2 Preparation of Surfaces: Dirt, oil, grease, and other foreign substances shall be removed from surfaces to receive grout. Loose material shall be removed from the concrete foundation by bush hammering, chipping, or by other means until sound, clean concrete is obtained. The surface of the foundation shall be left reasonably rough but not so rough as to interfere with proper placing of the grout. Concrete surfaces to be in contact with grout shall be thoroughly wetted with water one hour prior to grouting. Free standing water shall be removed before placing of grout.

2.32.3 Dry-Packed Grout:

2.32.3.1 Spaces under equipment baseplates shall be completely filled with dry-packed grout.

2.32.3.2 Dry-packed grout shall be a mixture of one part sand, one part cement, and water to suit. Grouting shall be continuous.

2.32.3.3 Grout shall be driven into place and thoroughly compacted with appropriate tools and equipment to assure complete contact between the grout and the baseplate and supporting concrete surfaces.

2.32.3.4 Poured Grout: Before placing grout, forms shall be made sufficiently tight to prevent leakage and shall be caulked where necessary. Adequate clearance between forms, baseplates, and items to be grouted shall be allowed to work the grout into place properly. The grout may be poured in place or pressure grouted by gravity. The means by which grout is placed shall be such that grout will completely fill the space to be grouted, be thoroughly compacted, and be free of air and water pockets. Whenever

practicable, grout shall be poured from one side only. If leveling devices such as shims are to be removed, they shall not be disturbed for at least 48 hours after the grout has been placed. Holes shall then be dry packed.

2.33 TESTS AND ACCEPTANCE

2.33.1 During the progress of the Work and upon completion of each phase of Work, Contractor shall test and ring out circuits installed hereunder and make such other tests as are necessary to insure that the wiring is installed and connected in accordance with the wiring diagrams. Corrections shall be made at Contractor's expense. Test methods shall be submitted in writing for approval by PG&E. Results shall be documented.

2.33.2 Contractor shall neither cause nor allow any of its Work to be covered up until it has been inspected by PG&E's on site inspector and approved by PG&E and local authorities having jurisdiction over the Work.

2.33.3 Contractor shall provide testing as specified in the CWA or this Contract, including without limitation qualified assistance as requested by PG&E for equipment tests.

2.33.4 Upon completion of the ground systems, PG&E will perform a special grounding test. Contractor shall not make final ties to main ground grid without PG&E's on-site inspector permission.

2.33.5 Any portion of the Work which fails to operate to the satisfaction of PG&E, or any defects which are due to Contractor's Work, shall be remedied and made good by Contractor at its own expense before the Work will be accepted by PG&E. Contractor shall not be held responsible for any original defects in equipment and materials furnished by PG&E.

2.33.6 During construction and prior to operation, switchboards, AC/DC panelboards and miscellaneous electrical equipment shall be thoroughly vacuum cleaned.

2.34 CONCRETE TESTING: The Contractor shall provide the services of an independent testing agency to perform tests on concrete materials, concrete mix designs, and concrete during the course of the Work. Testing, evaluation and approval of concrete shall be done in accordance with the requirements of Chapters 16 and 17 of ACI 301. Any concrete that does not meet the requirements shall be replaced at no additional cost to PG&E.

2.35 CONSTRUCTION QUALITY ASSURANCE

2.35.1 Items constructed in conjunction with permits issued by the Authority Having Jurisdiction shall be subjected to the quality assurance requirements of Chapter 17 of the California Building Code (CBC). PG&E will retain the services of a Special Inspection Agency to perform the Special Inspections required by the CBC. Contractor shall cooperate with the Special Inspection Agency and personnel of the Authority Having Jurisdiction, to allow access for the making of tests and inspections, and shall coordinate construction schedules with PG&E's Inspector to facilitate such tests and inspections.

2.35.2 Construction and installation of items not covered by B.5.1 shall be subjected to the quality assurance requirements defined by PG&E Construction Quality Assurance Requirements (Document 109 from Table 1).

2.35.3 "PG&E Construction Quality Assurance Requirements" is intended to be a PG&E internal document developed (if not already existing) by PG&E Construction Dept., specifying the tests and inspections to be performed or directed by PG&E Inspectors over the course of an EPC project. For Civil work, this may include, but not limited to Specifications in Civil Specifications No. 5217, Mod. 4 (Document 113 from Table 1) and the following verifications and actions:

- 2.35.3.1 Concrete and reinforcement:
- 2.35.3.2 Reinforcing steel of correct size, splices, and embedded items were placed in accordance with the drawings and properly restrained before placing concrete
- 2.35.3.3 Correct concrete mix was delivered to the site
- 2.35.3.4 Concrete was properly handled and placed
- 2.35.3.5 Concrete cylinder tests to be taken for the following conditions:
 - 2.35.3.5.1 Proposed variations to standard mix designs
 - 2.35.3.5.2 Circumstances requiring accelerated curing time
 - 2.35.3.5.3 Pouring concrete outside normal temperature range (Cold/Hot weather pours)
 - 2.35.3.5.4 Pumped concrete
 - 2.35.3.5.5 Mass concrete - i.e., large footings, slabs creating large thermal and volume changes
 - 2.35.3.5.6 Pouring against corrosive soils
- 2.35.3.6 Correct grade of reinforcing steel is used, if welded

2.35.4 Steel

- 2.35.4.1 Steel structure elements match the general configuration indicated on the drawings
- 2.35.4.2 Visual inspection of field-made structural welds
- 2.35.4.3 Welding is performed in accordance with approved WPS's by qualified welders
- 2.35.4.4 Correct grade and size of bolts and connectors are installed
- 2.35.4.5 High strength bolting is installed in accordance with the drawings

2.35.5 Anchor bolts

- 2.35.5.1 Anchor bolts of the correct size, grade, and configuration are placed in accordance with the drawings.
- 2.35.5.2 Post-installed anchors are installed in accordance with the manufacturer's instructions and the applicable ICC report.

2.35.6 Masonry

- 2.35.6.1 Reinforcement of proper size and configuration was used.
- 2.35.6.2 Cells of hollow units were grouted in accordance with the drawings.
- 2.35.6.3 Tests

2.35.7 Excavation, grading and paving

- 2.35.7.1 Compaction and moisture content are in accordance with the drawings
- 2.35.7.2 Refer to Civil Design Standard 041838, Generate Notes for Grading and Paving for Substation

2.35.8 Documentation

- 2.35.8.1 Records/ checklists of tests and inspections shall be maintained until project closeout.

3 SUBSTATION TECHNICAL REQUIREMENTS

3.1 COMPLIANCE

- 3.1.1 Unless otherwise specifically stated in the CWA, the Project shall be designed, rated, manufactured, installed and tested in accordance with the latest PG&E standards.

(See Reference Documents, Documents 2 to 110 from Table 1). If the equipment and material is manufactured outside the United States, the more stringent United States or International standards shall apply.

3.2 SERVICE CONDITIONS

3.2.1 PG&E customers are a top priority.

3.2.2 The equipment shall operate satisfactorily outdoors in all weather conditions at the specified location on PG&E's system.

3.2.3 The equipment shall be suitable for satisfactory operation under conditions of windblown dust, sand and rain.

3.2.4 The equipment shall be designed to operate from Mean Sea Level to an altitude of 1,000 meters and in an ambient temperature range between -10°C and 45°C .

3.2.5 The equipment shall be designed to withstand winds up to 100 miles per hour and gusts up to 120 miles per hour.

3.2.6 The equipment, accessories, and supports shall meet the requirements in Section C.4, Seismic Requirements.

3.2.7 The effect of wind and seismic event need not be considered together.

3.2.8 Refer to Document 49 from Table 1 for the appropriate Class insulation district.

3.3 MAIN COMPONENTS

3.3.1 TRANSFORMERS

3.3.1.1 PG&E will furnish required Transformer Bank for the Project. Transformer will be FOB on the foundation pad. Transformer foundation pad shall be designed and installed by Contractor. PG&E will be responsible for the dress and test of the Transformer Bank. Manufacture design drawings shall be provided to contractor when available. Contractor shall provide design details associated with anchoring of the bank to its foundation, welding of foundation embedment to the bank, equipment grounding as well as its terminal connections and integration into the substation (power, control, instrumentation, protection and SCADA systems). Grounding of the Surge Arresters will meet PG&E Design Standards.

3.3.2 HIGH VOLTAGE CIRCUIT BREAKERS (HVCBs):

3.3.2.1 High Voltage Circuit Breakers will be outdoor, dead tank type and will meet the applicable general and specific technical requirements of PG&E Specification 3611 and the latest addendum for breakers (Document 12 from Table 1), Spec 2790 (Document 12A from Table 1 for 500Kv HVCBs) and to the specific job requirements stated in the following paragraphs. Contractor to develop detail design in anchoring the breaker to the foundations, and welding of the foundation embedment to the embed(s), as well as its terminal connections and integration into the substation (power, control, instrumentation, protection, and SCADA systems).

3.3.2.2 The HVCB shall operate satisfactorily outdoors in all weather conditions described in Section C.2 of these Specific Conditions. They shall also comply with the seismic requirements specified under Section C.4. The HVCB shall be capable of continuously withstanding open circuit voltage, including any transient voltage, without

degrading individual components.

3.3.2.3 Each HVCB shall also be furnished with a pole discrepancy timer to give an alarm and trip signal if a discrepancy in the position of three poles of the circuit breaker persists for longer than the pre-set time. The time setting range shall be 1 - 5 seconds and the relay shall be provided with a visible operation indicator.

3.3.2.4 Contractor shall install the necessary number of wires to accommodate bringing all breaker contacts into the control building. For the purpose of the number of contacts, the two points of the contacts (positive and negative sides) shall be treated as separate and independent. Any common use of contacts shall be formed inside the control building. Spare wires at both ends shall be labeled taped and coiled for future use.

3.3.2.5 The Contractor shall undertake the dress and test of the HV Circuit Breakers (See Document 72 from Table 1).

3.3.2.6 Sulfur Hexafluoride (SF6) gas used in High Voltage Circuit Breakers is an extremely potent greenhouse which must be properly managed. The proper management and record keeping of SF6 has now been elevated to "critical" status because it is now mandated by law (assembly Bill 32). The California Air Resources board shall impose heavy penalties for AB32 violations if proper procedure is not followed. To meet the reporting requirements of this new California state law and the U.S. Environmental Protection Agency, follow the requirements outlined below. PG&E has established special pricing and handling through our contracted SF6 management supplier, Advanced Specialty Gases, to aid in the SF6 procedure.

3.3.2.7 Unless specified otherwise in a CWA, all SF6 gas in cylinders for this contract shall be purchased from:

Advanced Specialty Gases
Attn: Mr. Dave Stein or Brian Hamilton
135 Catron Dr.
Reno, NV 89512
Tel (775) 356-5500
Fax (775) 356-5571
Email: dave@asg-gas.com or brian@asg-gas.com

3.3.2.8 Document copies of SF6 gas purchased from ASG shall be made available to PG&E Construction Inspector on site for validation of gas purchases.

3.3.2.9 Contractors shall conduct an annual inventory of SF6 cylinders. PG&E will notify the Contractors of annual inventory date two weeks in advance. It is normally around the end or beginning of each calendar year. The following information is required from the Contractor no later than the annual inventory date:

- a) Date when inventory was conducted.
- b) Cylinder serial number.
- c) Cylinder supplier (should be ASG).
- d) Tare weight (located on the cylinder collar).
- e) Actual Weight if gas was removed from cylinder (contact ASG for assistance in weighing cylinders).
- f) Substation Name.
- g) Contact person and Contractor Company name.

3.3.2.10 Use form in Document 12C from Table 1 for the above data reporting.

Send completed form via email to PG&E project engineer.

- a) Do Not abandon SF6 cylinders at the job site once the project is complete. Contact ASG for instructions on getting the cylinders back to ASG for tracking and weighing purposes.
- b) Do Not move cylinders from one job site to another without first contacting ASG and reporting the cylinder serial numbers and the "to" and "from" locations. State Law requires that we know where the SF6 cylinders are at all times!
- c) Contractors shall report any accidental release of SF6 to the PG&E inspector immediately with the estimated amount of released SF6 in pounds, or the SF6 gauge pressure before and after the release. Record circuit breaker make, model, serial number and ambient air temperature. Cylinders used for initial fill can also be used for re-filling prior to project completion, but the amount leaked to atmosphere must be reported!
- d) Example: Contractor completes initial filling of new circuit breaker. Prior to completion of project, a leak is discovered and the breaker needs repairing and re-filling. The release must be reported to the PG&E inspector. The breaker is topped-off with SF6 using one of the project cylinders.

3.3.1.10
projects

The following vendors are approved for furnishing HVCB's for these

ABB Power T&D Company

Mitsubishi Electric

There are certain ABB and Mitsubishi breaker models that are not approved. They are:

- ABB type 72PM40
- ABB type 72PM31-30
- ABB type 121PM63
- MEPLI type 100-SFMT-63J

3.3.3 DISCONNECT SWITCHES:

- 3.3.1 The Contractor shall supply disconnect switches ahead of major components. Disconnect switches shall be provided as shown on the single line diagram. All disconnect switches shall be three-phase group operated type. All switches shall be designed in accordance with the PG&E specification 6757 (Document 13 from Table 1) and Specification 9149 for 500kV (Document 13B from Table 1).
- 3.3.2 Air disconnect switches shall be complete with controls, insulators, support structures and accessories. They shall be designed and constructed to operate satisfactorily in the environmental conditions described in Paragraph 2.0, of this Section C.
- 3.3.3 Air disconnect switches shall conform to and meet applicable requirements of the latest revisions of ANSI C37 - Switchgear Standards, general technical requirements of PG&E Specification No. 6757 (Document 13 from Table 1) and Specification 9149 (Document 13B from Table 1), and to the specific job requirements given in the following paragraphs.
- 3.3.4 Disconnect switches shall be 3-pole, single-throw, vertical or center side break, mounted in a horizontal upright position.

- 3.3.5 Disconnect switches shall be adequately sized to carry the maximum steady-state and dynamic current that could flow in them (rms of fundamental and harmonics), as well as the momentary currents due to faults. All current carrying parts shall be of high conductivity copper or aluminum and they together with supporting insulators shall be mounted or attached to galvanized steel bases to provide rigid support when mounted on their support structures. Switches shall be constructed such that there are no dissimilar metals on the moving parts.
- 3.3.6 Each disconnect switch operating mechanism shall have an operating platform installed in accordance with PG&E Engineering Standard drawing 034851 (Document 14 from Table 1). Operating platforms shall be bonded to the air switch operating mechanism.
- 3.3.7 The insulators shall be station post type and shall meet PG&E Engineering standard drawing 067906, (Document 15 from Table 1). Optional: For 60 to 115kV, polymer insulator are allowed to be installed on disconnect switches. Obtain concurrence from PG&E project engineer for approved manufacturer.
- 3.3.8 Note: Contractor shall provide this information to PG&E soon after it is available from their Supplier for PG&E's review. Drawing review, transmittals and correspondence procedures shall meet the applicable requirements stated Document 69 from Table 1, Submittals for EPC Contracts.
- 3.3.9 The following vendors are approved to furnish disconnecting switches for this project:
- 3.3.10 Southern States is preferred – If Mitsubishi High Voltage Circuit Breakers are purchased.
- 3.3.11 Pascor is preferred – If ABB High Voltage Circuit Breakers are purchased.

3.3.4 INSTRUMENT TRANSFORMERS

3.3.4.1 VOLTAGE TRANSFORMERS

3.3.4.1.1 If Voltage Transformers are required to be furnished, they shall be furnished in accordance with PG&E Electrical Design Standard Sheet 459983, Rev. 7 (Document 17 from Table 1).

3.3.4.1.2 The following vendors are approved to furnish Voltage Transformers (PT's) for this Project:

3.3.4.1.2.1 Trench

3.3.5 COUPLING CAPACITOR VOLTAGE TRANSFORMERS

3.3.5.1 Coupling Capacitor Voltage Transformer (CCVT) shall be furnished by Contractor to provide a three-phase and single-phase bus and line voltage signal for protective relays, meters and controls in accordance with the Project-Specific Requirements.

3.3.5.2 CCVTs shall be designed and constructed to conform to the applicable requirements of ANSI Standard C93.1 and C93.2 and shall accurately reproduce the high side voltage during all the conditions specified in Paragraph 2.4 of and operate satisfactorily in the environmental conditions specified in Paragraph 2.0 of this Section C. Each CCVT shall be complete with grounding switch and carrier accessories.

3.3.5.3 CCVTs shall be furnished in accordance with PG&E Design Standard 459983 and 459984.

3.3.5.4 Each secondary winding of the CCVTs shall be rated 115 volts at full winding with taps for 69 volts.

3.3.5.5 CCVTs shall be pedestal-base mounted and furnished complete with support

structures. Ferrous parts, except stainless steel shall be hot-dip galvanized in accordance with ASTM Standards A385 and A386. The frame and support structure shall have sufficient mechanical strength to withstand without damage, all the stresses incident to proper handling and maintenance of the CCVTs. A 2-hole NEMA ground pad on the external surface of capacitor base shall be provided. The ground connector shall be compression or exothermic -type, solderless suitable for receiving 250 kcmil copper cable. For physical installation of the CCVT's, refer PG&E Electrical Design Standard drawing 058104, (Document 19 from Table 1).

3.3.5.6 The radio influence voltage, when measured in accordance with NEMA Standard 107-1987, shall not exceed 500 microvolts.

3.3.5.7 Bushing shall be composite per standard 058104 (Document 19 from Table 1). High voltage terminals shall be electro-tinned copper, with flat pads. The bushings shall conform to the applicable requirements of IEEE. Means shall be provided to lift completely assembled CCVT.

3.3.5.8 Each CCVT shall be provided with a secondary gasketed compartment or terminal box with fuse base and insulated fuse holders with fuses for secondary windings. Polarity of windings shall be clearly marked. A suitable diagrammatic nameplate shall be installed on the inside of terminal cabinet near the terminal blocks.

3.3.5.9 The CCVT secondary wiring shall be minimum No. 10 AWG, 600-volt shielded, stranded copper wire, and shall be labeled MTW or MTW/(better rating) in accordance with NEC. It shall be provided with oil, gas, and moisture seals where it enters a chamber exposed to oil vapor. The secondary leads shall be clearly and permanently marked at the terminal blocks with the lead designation in accordance with NEMA Standard SG-4, particularly with respect to clearly designating the tap identity of each lead. All cables between each phase CCVT shall be shielded type. The shield and spare conductors of each cable shall be grounded at each end of the cable.

3.3.5.10 A master nameplate of corrosion-resistant material shall be affixed, to each CCVT, at the base housing of coupling capacitor stack. The nameplate shall contain, as a minimum, information specified in ANSI Standard C93.2.

3.3.5.11 CCVTs shall be subjected to design and routine tests in accordance with ANSI Standards C93.1 and C93.2. Complete certified test reports shall be submitted with test description and results.

3.3.5.12 Unless specified otherwise in a CWA, the following vendors are approved to furnish CCVT's for this Contract:

3.3.5.13 Trench

3.4 HIGH-VOLTAGE BUSES:

3.4.1 The current rating of the high-voltage buses and leads connecting the bus to the lines shall be adequate to meet the ultimate load cycle. The temperature rise of the buses and leads shall not exceed 30°C when carrying rated current at an ambient temperature of 40°C, without sunlight, an emissivity factor of 0.5, with two feet per second wind perpendicular to the conductor. (See Document 23 from Table 1).

3.4.2 The Substation bus work, insulators, etc., shall be capable of withstanding maximum short-circuit currents.

3.4.3 The connections between the disconnect switches, high voltage circuit breakers, and line terminations may be done by a combinations of aluminum tubing and cable.

3.4.4 Bus work shall be dynamically analyzed using the seismic requirement of Paragraph 5 of this section C. Contractor shall provide all the calculations, for PG&E's review, to prove adequacy of

the sizes selected for the bus work and tap-offs.

- 3.4.5 Rigid bus conductors shall be round tubular shape, aluminum alloy 6063-T6. Rigid bus conductors shall conform to PG&E Engineering Standard No. 34(Document 52 from Table 1).
- 3.4.6 Flexible aluminum conductors can be used as buses or equipment taps. All aluminum conductors shall conform to PG&E Engineering Standard No. 87(Document 4 from Table 1) and IEEE draft standard P 1527/D7.
- 3.4.7 Maximum design ampacity of bus conductors shall be within the limits shown in PG&E Electrical Design Standard Drawings 067909, (Document 20 from Table 1) for conductors, and Engineering Standard Drawing 030559, (Document 21 from Table 1) and IB0186. Coprevent heat flow into the equipment connected under any conditions.
- 3.4.8 Rigid buses shall be designed to DCM C-1.4, Structural Design of Rigid Buses (Document 84 from Table 1):
- 3.4.9 maximum deflection of a bus span shall not exceed 1/200 of the span length.
- 3.4.10 The maximum force exerted on the support insulators shall not exceed fifty percent of their cantilever rating.
- 3.4.11 The fiber stress of the conductor not to exceed 25,000 lbs. /sq. in
- 3.4.12 The maximum force exerted on the support insulators shall be computed by assuming the simultaneous application of the maximum force due to short circuits and a maximum wind.
- 3.4.13 Provisions for thermal expansion of the rigid bus conductors shall be made. Connections for equipment bushings and terminals of switches and instrument transformers shall be provided with flexible connections.
- 3.4.14 All design calculations for the buses shall be submitted to PG&E for review and acceptance.
- 3.4.15 Rigid buses are required to operate corona-free during the maximum system operating voltage. Corona-free operation shall mean that the surface voltage gradient is below the negative corona onset, which occurs at 20 kV rms per centimeter.
- 3.4.16 Bus connectors are required to operate corona free when the surface voltage gradient on the bus is 10% above the design value.
- 3.4.17 Rigid bus insulators shall be NEMA station post type bus support insulators with adequate creepage distance and with sufficient strength to withstand seismic forces, short circuit forces and wind loading as specified. Use PG&E Engineering Standard 067906, (Document 15 from Table 1) as reference in selecting proper insulator. Deviations from this standard will only be permitted by PG&E approval. Suspension type insulators shall be selected in accordance with PG&E Standard Drawing No. 015014 (Document 16 from Table 1).
- 3.4.18 Line and bus hardware and connectors shall be selected in accordance with the PG&E Engineering Standard Drawing 046267, (Document 22 from Table 1), 068008 (Document 104 from Table 1), 436340 (Document 103 from Table 1), and 064116 (Document 102 from Table 1).
- 3.4.19 Requirements for control of wind vibration of tubular aluminum bus shall conform to PG&E Electrical Design Standard Drawing No. 052646(Document 23 from Table 1).
- 3.4.20 Aluminum-to-aluminum and copper-to-aluminum connection shall be designed in accordance with PG&E Engineering Standard Drawing 037788, (Document 24 from Table 1).
- 3.4.21 Electrical clearances for outdoor construction shall be in accordance with the recommendations in

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ANSI Standard C37.32, and in accordance with PG&E Electrical Design Standard drawing # 067908, (Document 53 from Table 1).

3.5 STRUCTURES:

- 3.5.1 Elevating support structures shall be galvanized, conforming to applicable sections of PG&E Engineering Standard Spec. No. 30 (Document 10 from Table 1), or with PG&E Engineering Standard Spec. No. 81 (Document 11 from Table 1), respectively.
- 3.5.2 All drilled and cut edges shall be de-burred.
- 3.5.3 The following vendors are approved to furnish PG&E with steel structures:
- 3.5.4 Valmont Industries, Inc.
- 3.5.5 Structural members and connectors shall be finished in accordance with PG&E Engineering Standard Nos. 30 and 81. Alternately, when specified on drawings, structure members (exclusive of nuts and bolts) shall be painted. Approved paint products are as specified below and shall be applied in accordance with PG&E Engineering Standard No. 81 (Document 11 from Table 1).

3.5.5.1 Inorganic Zinc Primer:

- 3.5.5.2 Ameron
- 3.5.5.3 Mobil Chemical
- 3.5.5.4 Napko
- 3.5.5.5 Porter Coatings
- 3.5.5.6 Dimetcote 6
- 3.5.5.7 Mobilzinc 7
- 3.5.5.8 Napko K
- 3.5.5.9 Zinclock

3.5.6 Acrylic Finish Paint:

- Ameron
- Mobil Chemical
- Napko
- Acrylic No. 234
- Acrylic Latex-79 Series
- Thixacryl 4660 Series

3.5.7 Silicon Acrylic Finish Paint:

- Sicon
- Porter Coatings
- "MA" Silicon Acrylic
- Silicon Acrylic 28 series

3.6 CONTROL AND RELAY SWITCHBOARDS

3.6.1 Switchrack panels shall be provided for the control, metering and protection equipment. The panels shall be designed and constructed of simplex type 19 inch switchrack assemblies, 7 feet – 6 inches high, 48 rack units with 7.5 inch rack spacer. (For switchrack panel installation inside MPAC buildings, See Figure V-1 to V-4. Document 94 from Table 1).

3.6.2 The switchboard shall be provided with adequate lighting both inside and outside. Emergency lighting shall be provided in the event that AC power is lost.

3.6.3 The switchboard shall be provided with a ground buss located behind the bottom of the relay and the control panels. The bus size to be ¼ inches x 2 inches flat copper bar and shall be mounted on the switchboard's base channel.

3.6.4 Control and relay equipment and devices shall be rated for 125 VDC nominal control voltage, with capability for operation at 140 VDC as defined by paragraph 6.2 of ANSI/IEEE Standard C37.90. Solid state and microprocessor type relays require separate test switches. These test switches shall be ABB Type FT-1 (Document 58 from Table 1).

3.6.5 Current and voltage transformer circuits shall be grounded at the switchboard only.

3.6.6 Each circuit breaker control shall have a separate DC supply. Refer to PG&E Guideline for High Voltage Circuit Breaker AC and DC Circuits (Document 28 from Table 1).

3.6.7 DC supply circuits for solid state relays shall in accordance with PG&E Substation Engineering Memo of April 23, 1990 (Document 29 from Table 1). To prevent loss of data through interruption of DC power supplies to digital relays refer to Document 29A from Table 1).

3.6.8 Fuses for voltage transformer circuits shall be provided at the voltage transformer, not at the switchboard.

3.6.9 Indicating instruments shall be multi-function digital meters, 1 percent full scale accuracy. Instrument coils shall be transformer rated for use with 5-ampere CTs and 120-volt PTs.

3.6.10 All protective relays shall be selected for operation from transformers having nominal 5 amperes and 120 volts secondary. Relays shall be semi-flush mounting and provided with resettable targets.

3.6.11 The relay system shall meet the surge withstand capability test specified in ANSI Standard C37.90.1-1989.

3.6.12 Control and test switches shall conform to PG&E Substation Electrical Design Guidelines Manual – Section 4.29, and PG&E Engineering Standard Drawing 023607, (See Document 30 Table 1).

3.6.13 An annunciator if required, shall be mounted on the switchboard for operation on 125 VDC and shall be wired and equipped with a sufficient number of windows to accept all the alarms plus a minimum of 20 percent spare capacity. The annunciator shall conform to the specific technical requirements of PG&E Specification No. 6356 (Document 31 from Table 1) and shall be suitable for connecting an indoor sounder and outdoor horn. A ground detector, as specified in paragraph 7.18 of Specification No. 6356, shall be provided.

3.6.14 The following vendors are approved to furnish PG&E with Annunciators:

3.6.14.1 Puleo

3.6.15 Indicating lights shall be LED bulbs with translucent color caps. See Engineering Standard Drawing 023607 (Document 30 from Table 1).

3.6.16 Switchboard control wiring shall be type SIS type. The size of wiring shall be No. 14 AWG minimum. Connections to hinge panels shall terminate in terminal blocks attached to the hinge panel and to the terminal blocks on the stationary frame. Set of bare metal jumpers anywhere on the switchboard will not be permitted. See Document 57 from Table 1 for switchboard wire size.

3.6.17 Each wire shall be marked or tagged at the switchboard device and at the terminal block with white heat shrinkable wire markers, Critchley or approved equal. Wire tags shall include the

wire destinations and the tags shall not be heat shrunk. Also, the tags shall be sleeve type, movable and can cover the wire termination.

3.6.18 Terminal connections shall be made using non-insulated compression type ring tongue terminals as specified in PG&E Engineering Standard Drawing No. 054552, (Document 32 from Table 1).

3.6.19 Control wiring shall terminate in molded screw type standard terminals blocks per PG&E Engineering Standard Drawing 057384, (Document 33 from Table 1), which shall be mounted in accessible locations at the rear of each panel. All conductors of a multiconductor cable shall be terminated in the same panel. For suggested location of terminal blocks on switchboards, see PG&E Electrical Design Standard Drawing 445471, (Document 34 from Table 1).

3.6.20 Short circuit type terminal blocks shall be used for current transformer circuits at the breaker control cabinet for CT circuits not being used.

3.6.21 Terminal blocks shall be provided in sufficient quantity to permit termination of all incoming wiring and shielding plus 20 per-cent spare terminals.

3.6.22 Not more than two (2) wires shall be connected to any one terminal point. Connection between terminal points (jumpers) shall be made with approved type control wire as specified above.

3.6.23 Vertical wiring on the boards between the terminal blocks and the switchboard devices shall be run in the metallic gutters. Horizontal wiring between the gutters and the devices may be exposed. Horizontal wiring between the front and rear panels of the duplex switchboard shall be run in the horizontal transverse gutters. All exposed wiring on the boards shall be run neatly with square corners, and neatly grouped in packs using wire cleats or bands, and with groups substantially supported along the board.

3.6.24 The arrangements and mounting of equipment and wiring shall be such that complete accessibility to studs and contacts will be maintained. Where it is necessary to mount equipment behind studs or contacts, at least 6 inches of clearance shall be provided.

3.6.25 Special attention shall be given in selecting the right size, the correct designation and the proper location of nameplates. PG&E Electrical Design Standard Drawing 042909, (Document 35 from Table 1) and Engineering Standard 027818 (Document 36 from Table 1) show the proper selection of nameplates for substations. Each device, whether mounted on the face of the board or inside, shall be provided with proper nameplates. In general, the nameplates shall be located above the equipment described and two nameplates per device are needed – one on front and one on back of the switchboard. Nameplates shall be fastened to panels with self-tapping sheet metal screws, No. 2-56 Parker Kalon Type F binding Parkerized heads. Alternate method of mounting nameplates is to use double-sided adhesive tape that uses an acrylic polymer based adhesive three (3) mils thick with an adhesive strength of 98 oz. per linear inch. Where nameplates occur at the same point on both the inside and outside surface of a panel, machine screws and nuts having the same head shape and finish as the drive screws may be substituted.

3.6.26 All mimic buses shall be in accordance with voltage class as specified in PG&E Engineering Standard Drawing 023607, (Document 30 from Table 1). For MPAC installations no mimic buses are required.

3.7 CONTROL AND METERING EQUIPMENT

3.7.1 For MPAC installation no metering devices shall be required. The IPAC relays shall provide this function. For conventional microprocessor relays, metering devices shall be digital, multi-function meters. The following control, metering and indicating devices, as a minimum,

shall be provided on the control switchboard:

- 3.7.2 Three phase currents for each line.
- 3.7.3 Three-phase Volts, Vars and Watts for each line.
- 3.7.4 Multi-function meters.
- 3.7.5 Three-phase currents for each breaker.
- 3.7.6 One (1) circuit breaker control switch with indicating lamps for each breaker.
- 3.7.7 One (1) Manual/Automatic control switch for each breaker.
- 3.7.8 One (1) Local/Remote control switch for each breaker.
- 3.7.9 One (1) Synchronizing Switch for each breaker.
- 3.7.10 Potential feature and Relay Cut-in and Cut-out Switches.

3.7.11 The Contractor shall provide, install and wire transducers for telemetering the currents, vars and bus voltages when not available from the multi-function meters. Power supply for the transducers shall be taken from the substation 125V DC supply when required. Digital Multifunction Meters shall be used and connected to the SCADA RTU using serial communications (RS232 and RS 485).

3.7.12 Contacts shall also be provided for telemetering the status of circuit breakers.

3.7.13 To facilitate SCADA control of circuit breakers, solenoid operated control switches, ElectroSwitch Type CSR and LSR, shall be used. For MPAC installations these functions are provided by protection relays.

3.7.14 If required, the following vendors are approved for furnishing meters:

3.7.15 BITRONICS

3.7.16 Electro-Industries

3.8 PROTECTION REQUIREMENTS

3.8.1 Refer to PG&E Protection Requirements. This document shall address the protection requirements for the final Engineering Design and Construction Package. It will also include specific protection requirements for line and equipment clearances during each phase of construction.

3.8.2 Relays and supplementary equipment shall be mounted on the switchrack specified in Paragraph 3.7 of this Section C. The protective relays shall receive their sensing current signals from the bushing current transformers and the voltage signals from CCVTs and/or PTs.

3.8.3 Protective equipment shall operate correctly when the air temperature outside the equipment enclosure is in the range of -20 C to 55 C. Temperatures in this range shall not cause any component failure or excessive component aging. The protection system shall comply with the surge withstand capability as specified in ANSI/IEEE Standard C37.90.1.

3.8.4 All protection equipment and systems are to be properly coordinated to prevent incorrect operation of the protection equipment or systems. It shall also be secure from false operation under any condition.

3.8.5 The protection equipment provided for the Substation shall be coordinated with PG&E's system. Refer to Document No. 50 from Table 1 for approved relays.

3.8.6 Contractor shall be responsible for calibration and test of all protective relays supplied.

3.8.7 A separate dry contact for each level of alarm, lockout, timing and relay operation shall be provided and connected to the station annunciator. For MPAC installation, alarms are brought back to the HMI via protective relays.

3.9 STATION SERVICE

3.9.1 Contractor shall verify the size of the existing battery, charger and panelboards to meet station new load cycles. Contractor shall submit calculations to PG&E for approval. Contractor shall use Specification for Furnishing and Delivering of Batteries and Battery Racks, PG&E Spec. No. 6679, (Document 38 from Table 1) in procuring the battery and racks, if required. Contractor shall use Specification for Furnishing and Delivering of Regulated Battery Chargers, PG&E Spec. No. 1546, (Document 39 from Table 1) in procuring the charger. A battery voltage monitor similar to McKaig Model 7130DC is required to monitor the 125 VDC system voltage (See Document No. 63 from Table 1 for DC Distribution Panelboards).

3.10 WIRING, TERMINALS, TERMINAL BLOCKS, AND TERMINATION CABINETS

3.10.1 Contractor shall furnish all control and instrument wiring including inter-phase and inter-cabinet wiring for the Project. Wiring external to the cabinets and housings shall be non-shielded type and shall run in conduit or other suitable metal enclosures, adequately supported, rain-tight, and dust-tight. Flexible conduit shall be metallic type with a protective weatherproof sheath. Rigid nonmetallic conduit or corrugated flexible conduit will not be accepted.

3.10.2 Non-shielded cable shall be used for all control wiring, and current transformer circuits, convenience outlets and lighting circuits outdoors. Shielded cable shall be used for all 500kV switchyards, capacitor banks and potential circuits from CCVTs. The shield shall be solidly connected to the ground bus (ground grid) at both ends. Shielded cables entering the control building shall have their shields terminated and grounded at the bottom of the racks, panels or equipment. (See Document 86 from Table 1 for applicable cable types and Document 57A from Table 1 for Fault Press Relay shielding requirements).

3.10.3 Power and control wiring shall be rated 2000 volts and 600Volts minimum respectively, stranded copper wire in accordance with requirements of Document 86 from Table 1. Type XLPE-PVC for non-shielded cables and Type XLPE-CPE for shielded cables. Wiring shall have a continuous current carrying capacity, as determined by the National Electrical Code, equal to or greater than the applied current. The cable fill in conduits shall not exceed the stipulated fill requirements of the NEC.

3.10.4 The insulation shall be flame-retardant, moisture, heat, and oil resistant thermoplastic suitable for dry or oil-immersed service continuously at 90°C or higher temperature, and shall meet all requirements as defined by applicable UL, ICEA-NEMA, and ASTM standards.

3.10.5 The power and control wiring shall be surface-printed using the indent printing process with the manufacturer's name, AWG size, voltage class, NEC type dry and oil-immersed temperature ratings, or verification of temperature ratings in writing by the equipment manufacturer.

3.10.6 Power wiring shall not be smaller than No. 12 AWG.

3.10.7 Control wiring within the equipment supplied by the Contractor shall be properly sized for the required duty and fuse protection.

3.10.8 Power and control wiring shall be substantially supported and protected from severe vibration and mechanical injury. Wiring between cabinets shall be in metal conduits.

3.10.9 Wiring which is flexed by the opening of cabinet doors or swinging panels shall be 600 volt, NEC type MTW or better, No. 12 AWG, 65 strand copper flexible hinge cable.

3.10.10 A minimum of fifteen (15) percent spare terminals shall be provided.

3.10.11 Terminal blocks shall be standard molded, washer-head screw type, with white marker strip suitable for engraving, General Electric Co. Type EB-25 or an approved equivalent in accordance with PG&E Engineering Standard Drawing 057384, (Document 33 from Table 1).

3.10.12 Terminal blocks shall be mounted in a readily-accessible and unobstructed locations.

3.10.13 Terminal blocks connections shall accommodate wire sizes up to No. 6 AWG. No more than two wires shall terminate at any one terminal. Terminals and terminal blocks shall be legibly marked.

3.10.14 Power and control wire terminals shall be uninsulated, electrolytic copper and electro-tinned, teardrop ring compression type terminals with brazed barrel and terminals shall be installed with terminal manufacturer's recommended ratchet-type tool. Terminals and ratchet-type tools shall be as listed in PG&E Engineering Standard Drawing 054552, (Document 32 from Table 1). No metal jumpers shall be used.

3.10.15 Wire terminal connectors used with screw type terminal blocks shall be ring tongue wire terminals, non-insulated compression type, in accordance with Drawing 054552, Table 1, and shall be installed with an approved tool per Table 2. For device terminals which are too small to accept PG&E's standard wire connectors, appropriately sized non-insulated ring tongue terminals shall be used. These smaller terminals shall be obtained from one of the approved suppliers as listed on standard 054552 (Document 32 from Table 1). Insulated terminals could be used with prior approval from RE who will coordinate its Acceptance with Construction prior to its application. These shall be considered also for use on devices where terminal spacing is so close that shorting of adjacent connections is possible. Ferrules or pins shall be placed on all stranded wires that terminate on devices that will not accept ring tongue terminals. Other termination methods require approval by PG&E.

3.10.16 Pre-formed angle (45degree and 90degree) compression type wire terminal connectors shall be used for recessed screw type terminal blocks, such as found on Alstom relays, or where needed to provide the best access when the device terminals or wiring is concentrated. Manual bending of connectors is unacceptable and is prohibited. Pre-formed angle connectors shall be obtained from one of the approved suppliers as listed on standard 054552. 90 degree ring tongue connectors from Hi-Line, Inc., Part No.22C83608R90 ((800) 944-5463) are also acceptable. The insulated terminal connector furnished with Alstom devices may be used if applied with proper tool (Thomas & Betts, Cat No.WT145C). As an alternate Panduit Crimp Tool certified for insulated lugs is acceptable, subject to the approval by PG&E.

3.10.17 Approved manufacturers for 90 degree terminal connectors should be the same as straight connectors as shown on ES Drawing. 054552: AMP, Burndy, 3M, Panduit, T&B. These terminals shall conform to applicable UL requirement. (See Document No. 32 from Table 1).

3.10.18 With regards to the issue of the terminal hole size larger than the stud size. Use of inappropriate and incompatible studs and stud connectors such as using #10 stud connectors on #8, #6 studs and manually bending sta-kons hand for the 90 degrees, etc. is prohibited.

3.10.19 One acceptable practice is the use of factory 90 degree sta-kons made by Davico. They make them in insulated and non-insulated. Non-insulated 90 degree connectors could be used on GE Relays and insulated 90 degree connectors could be used on the MVAA's. Straight connectors could be used for SEL relays. PG&E acceptable supplier is Bulldog Domestic. Contact: Greg Heck (PG&E Vendor ID: 1013566).

3.10.20 All wiring inside the Panels and wiring from Panel to Panel shall be in accordance with the requirements of Document 57 from Table 1, " Control and Switchboard wire, Section 6.2 of Substation Maintenance and Construction Manual, followed by Document 86 from Table 1, DCM E5.8, Low Voltage Cable Systems. Document 57 from Table 1 allows the use of #14 AWG wire inside the panels and between adjacent panels (between control and/or protective

relay device to device).

3.10.21 With regards to terminals straight, 45 degree bent, or 90 degree bent all have to be either insulated or non-insulated terminals, UL labeled or factory made. No manually bent terminal lugs are permitted. If non insulated factory made bent lugs are not available, they could be substituted by UL labeled factory made insulated bent lugs, with the provision that they be installed either by a crimp tool specific for use with insulated lugs. PG&E accepted tool is by T&B and with prior PG&E approval use of Panduit Crimp tool would be permitted. In any event, a random test shall be made to ensure that they pass the UL pull out test.

3.10.22 With regards to stud connectors and studs they shall be utilized in strict accordance with the catalog instructions of the respective manufacturer. Some brands permit one size higher, and some restrict the size specific to the stud and stud connector. This should be checked out prior to their respective application or run the risk of being rejected for re-work withers by PG&E SQC staff at the factory or at the field by PG&E construction/Inspection Staff.

3.10.23 The wire to be terminated shall be stripped free of insulation, using a fixed jaw wire stripper, without nicking or severing any strands, 1/8 inch, longer than the terminal barrel. A 1/16-inch length of bare conductor shall be exposed at each end of the terminal barrel when crimped.

3.10.24 Terminations shall provide a permanent, mechanically secure, and high conductivity joint.

3.10.25 Power and control wiring shall be clearly and permanently marked with Contractor's wire designation at the device and at the terminal block with a PG&E approved wire marker.

3.10.26 Current transformer wiring shall be terminated in molded, washer head, or binder head screw type short-circuiting terminal, with terminal marking strips. Each current transformer shall be terminated on a separate short-circuiting screw type terminal block. Wire terminals and their application shall be the same as power and control wires indicated above. Current transformer wiring shall be sized depending on the length of the circuit and in no case be less than No. 10 AWG.

3.10.27 Terminals and bare energized parts on devices, terminal boards, knife switches, fuses, etc., with voltages over 110 volts shall be guarded to prevent accidental personnel contact.

3.10.28 Closing and trip coil leads, instrument transformer secondary leads and other similar wiring shall be securely attached to their coil mechanically, in addition to any required electrical connection.

3.10.29 Lighting and convenience outlets shall be wired so that no live parts are exposed.

3.10.30 Contractor shall select the single and multi-conductor cable sizes. Wire sizes shall meet the ampacity requirements for the maximum expected load of the circuit without exceeding the maximum allowed voltage drop or CT burden. However in any case, except for telecommunication wiring, no wire shall be smaller than No. 10 AWG for outdoors and no smaller than 14 AWG for indoors. Multiconductor cables used for the HVCB control circuits shall have a minimum of two (2) spare conductors in each cable.

3.10.31 All control cable shall be installed in continuous lengths without splices. All connections shall be made at terminal blocks.

3.10.32 Control cables shall not be run in the same conduit with AC station service conductors. The AC station service conductors shall be run in separate conduits.

3.10.33 Termination Cabinets shall be provided where specified. Termination cabinets will be sized for the application and will contain TB's, ground bus, cubicle light, and receptacle.

3.10.34 Design and construction shall include installation of spare control wires between the breakers and the control room that can be used to wire up spare contacts in the future back to the control room and terminated on spare terminal blocks and that both sets of Current Transformer contributions be wired back to the differential cabinet. The same requirements are equally applicable to the auxiliary switch contacts of all HV disconnect switches. In addition, all spare contacts available from protective relays shall also be wired to the terminal blocks. The termination compartments shall be sized properly to accommodate this requirement.

3.11 DESIGN REQUIREMENTS

3.11.1 YARD LIGHTING AND CONVENIENCE OUTLETS:

3.11.2 The general criterion for outdoor lighting shall be to provide illumination to facilitate maintenance of the substation during hours of darkness.

3.11.3 Lighting fixtures shall be provided to illuminate all switching equipment and switch operating areas.

3.11.4 The following illumination levels shall be provided as a minimum:

General area illumination	0.5 foot-candles
Switch operating platforms	2.0 foot-candles
Vertical switch targets	4.0 foot-candles

3.11.5 Lighting fixtures shall be high-pressure sodium and assembled in accordance with PG&E Electrical Design Standard Drawing 459076 (Document 40 from Table 1) and Lighting Systems Design Criteria 073117 (Document 40A from Table 1).

3.11.6 Outdoor lighting circuits shall be provided with photocell control.

3.11.7 Convenience outlets for outdoor installations shall be provided in accordance with PG&E Electrical Design Standard Drawing 334754 (Document 41 from Table 1).

3.12 GROUNDING:

3.12.1 Contractor shall design and provide all material required for the grounding system based on the Grounding Report, including grounding of the substation perimeter fence as required (Document 9 from Table 1).

3.12.2 Unless otherwise specified in this Section, the grounding system design shall meet the requirements of PG&E Engineering Standard Drawing 067910, (Document 42 from Table 1).

3.12.3 The grounding system shall be designed to limit the tolerable step and touch potential, to establish a low resistance connection to earth and to limit the potential rise during maximum expected fault conditions and in accordance with IEEE standard 80.

3.12.4 Unless provided by PG&E, Contractor shall determine, by measurement, the value of the resistivity of the native soil to be used in the grounding calculations using CDEGS software package by Safety Engineering Services (See Document 42A from Table 1).

3.12.5 The measured ground grid resistance to earth, in dry soil, shall be less than 1 ohm.

3.12.6 The ground grid shall be buried a minimum of 18 inches below finish grade.

3.12.7 The main ground grid shall use 250 or 500 kcmil bare copper cable (See Document 42A from Table 1 for requirement).

3.12.8 Structures and all other equipment shall be grounded with 250 kcmil bare

copper cable and tied to the main ground grid.

3.12.9 Ground fences shall be in accordance with PG&E Engineering Standard Drawing 020607 (Document 9 from Table 1). For non-conductive fence used for Capacitor Bank perimeter fencing or other non-conductive fence requirement as specified in the scope of work shall be made of compression molded fiberglass reinforced plastic grating similar to AMICO (Alabama Manufacturer Industry Corporation) products. PG&E recommends the following as an experienced non-conductive fence installer:

3.12.10 If cable trenches are used, one (1) #6 bare copper conductor shall be installed in each cable trench to reduce transient voltage and noise in control circuits (See Dwg 391947, Typical Trench Section, Document No. 85 from Table 1). For 500kV yard two #6 bare copper conductors shall be installed in each cable trench to be attached to each side of trenches (inside near top). The #6 bare copper conductors shall be connected to the nearest ground grid on one end and the other end to the switchrack or switchboard grounding bar in the control room or MPAC building. There shall be no grounding at intermediate points.

3.12.11 Deutsch connector is the preferred method for underground and aboveground connections. (See Document 42 from Table 1, Sh 13 to 15).

3.13 RACEWAYS:

3.13.1 Raceway system shall be designed to accommodate all the necessary wiring for this Project and sufficient spare capacity for future installation. See Design Criteria 073120-Raceway, Conduit, Trench and Tray (Document 83 from Table 1).

3.13.2 All outdoor wiring shall be either in cable trenches or conduits. Indoor wiring may be in conduit, cable trays, or floor trenches.

3.13.3 Outdoor cable trenches shall consist of framing members, side sections, and removable cover sections assembled to form a completely enclosed trench, except with bottom drains. If soil is inhabited with earth boring animals, then the trenches shall be sealed to prevent them from entering the cable trench but allow for drainage. The covers shall be made of dielectric material with slots for lifting tools. Cable trenches can be pre-cast concrete or made of fiberglass materials. See Document No. 85 from Table 1, for Electric Cable Trench Requirements.

3.13.4 Top of cable trench removable covers shall be approximately 4 inches above the elevation of the finished rock surfacing, per PG&E Civil Design Standard Drawings 391946 and 391947 (See Document 85 from Table 1).

3.13.5 The outdoor cable trench shall be designed to allow vehicular traffic, with axle capacity of 32,000 pounds, AASHTO HS20, over any portion of the cable trench system.

3.13.6 Underground conduit shall be type PVC minimum Schedule 40, ASTM 512, suitable for direct burial without concrete encasement, as per PG&E Underground Construction Drawing 062288 (Document 43 from Table 1).

3.13.7 The top row of underground conduit runs shall be 2.5 feet below finish grade. Maintain the conduit runs as far as possible from the foundations of dead-end structures.

3.13.8 Conduit runs crossing under roadways shall be protected with a reinforced concrete cover suitable for an AASHTO HS20 loading. Extend the protection 5 feet beyond both edges of the road.

3.13.9 Provide adequate drainage of conduits between pull boxes. Slope conduits a minimum of 3 inches per 100-foot run. Also, install a 4-inch conduit between pull boxes near the bottom for drainage.

3.13.10 Pull boxes shall be reinforced concrete, with aluminum covers in accordance with PG&E Civil Design Standard Drawing 334929 (Document 44 from Table 1) and 335189, (Document 45 from Table 1).

3.13.11 Rigid Steel Conduit shall be used for above ground outdoor installations. For indoor installation electric metallic tubing conduit (EMT) may be used.

3.13.12 Main underground duct runs shall contain a minimum of twenty-five 25 percent spare conduits. Cable trench runs shall be loaded no more than twenty (20) percent of the usable cable space.

3.13.13 Rigid steel conduit shall be terminated at junction boxes and cabinets with insulated bushings. PVC conduit shall be terminated at pull boxes with end bells.

3.13.14 No conduit run shall exceed 250 feet, nor have more than three 90-degree bends between pull boxes.

3.13.15 The maximum allowable conduit fill shall be forty (40) percent of the conduit usable cross section area; except that two cables filling a conduit shall not exceed thirty-one (31) percent.

3.13.16 C.3.12.3.16. Cable trays, if used, shall be ladder type, with 9-inch rung spacing, galvanized steel.

3.13.17 Pull boxes and conduit systems: Where spare transite conduits are present they shall not be considered for re-use. Where spare PVC spare conduits are present they could be considered for re-use. However, care shall be exercised if partially filled conduits are proposed for consideration to add additional cables in them, by ensuring that the fill of the conduits is adequately addressed.

3.14 COMMUNICATION, TELEPHONE AND SCADA SYSTEMS:

3.14.1 The telephone system will provide for intercommunication within the substation for maintenance purposes.

3.14.2 Contractor shall design and install the communication system to implement transfer trip schemes, special protection schemes and SCADA.

3.14.3 Contractor shall engineer, provide, install and test the interface of SCADA Cards to be provided by the Contractor in the transformer Control Cabinet with the GE/HARRIS SCADA RTU and its peripheral modules in an MPAC or existing Control Building as required. Contractor shall coordinate with PG&E's Automation Engineering with regards to all aspects of incorporating SCADA/Automation requirements. Contractor will be responsible for the configuration of the RTU and will supervise the final functional testing of the RTU with the master stations. Refer to SCADA and Substation Automation Requirements.

3.14.4 Where SCADA Synchronizing is identified in the Workscope, the Synchrocheck relay that shall be used is Basler Model BE1-25, Catalog No. M1E-A6P-N4R0F. The Contractor shall pay particular attention to this feature in conjunction with PG&E's Project Engineer. For MPAC installation this function is accomplished by using the SEL relay. (See Document 94 from Table 1, Table IV-1).

3.14.5 Note: SCADA fiber optic cable needs to be inside 3-inch Fiber-Guard innerduct inside pull boxes. This is to ensure against crushing ALCOA Fujikura fiber optic cable in pull boxes, wrap it in Fiber-Guard (PG&E Mat Code Number 39-0041), a high-visibility orange slit flexible corrugated duct. Use Fiber-Guard in pull boxes only and include it in the B/M.

3.15 FIRE PROTECTION:

3.15.1 Contractor shall provide fire protection for the Substation in accordance with Design Criteria Memorandum, DCM-E-1.5. (Document 66 from Table 1).

3.16 CIVIL WORKS:

3.16.1 Scope: The scope includes the design of steel structures for the support of electrical equipment and overhead conductors, the design of structure and equipment foundations, the design of equipment anchorage, and design of site improvements at the

Substation yard. (See Documents 113, 77 & 78 from Table 1).

3.16.2 Structures, Foundations and Anchorages: Contractor shall document all foundation design criteria and prepare foundation construction plans and specifications including documentation of structure and equipment design loads and allowable design forces.

3.16.3 New Structures, Foundations and Anchorages: Structures, foundations and anchorages shall be designed for service and environmental conditions in accordance to Document 78 from Table 1.

3.16.4 Use of Existing Structures, Foundations and Anchorages: Existing structures, foundations and anchorages at the site may be used, provided that all of the following conditions are met:

- PG&E approves such use.
- Existing structure and its foundation and anchorage is capable of resisting statically applied (e.g. gravity loads, line tension, soil pressure) and sustained loads (e.g. wind, ice) in accordance to Document 78 from Table 1.
- Structural elements and connections, whose function is to attach and transfer equipment seismic loads that satisfy requirements of Document 78 from Table 1.

3.16.5 Use of Existing PG&E Civil Design Standards: Existing PG&E civil design standards (CDS) for Structures, foundations and anchorages may be used, provided that all of the following conditions are met:

- PG&E approves such use.
- The existing CDS is appropriate for use (see Document 78 from Table 1).

3.16.6 Detailing of Structures: Structures shall be detailed in accordance with PG&E Engineering Standards 30 & 81(see Documents 10 & 11 from Table 1).

3.16.7 Equipment Support foundations: Equipment support foundations will be required under major pieces of equipment. The foundations shall extend at least 12 inches beyond each side of equipment. Concrete for reactor footings and foundations shall be reinforced with non-ferrous materials when recommended by equipment manufacturer.

3.16.8 Reinforcing Bar Anchor Bolts: #14J or #18J reinforcing bar anchor bolts are acceptable provided the following conditions are met:

- Projected and threaded length shall be equal to five times the nut height or four times the nut height plus the base plate thickness whichever is greater.
- Develop anchorage according to ACI 318. Embedded length shall be not less than $L_d \times 1.5 \times (\text{design load}) / (\text{yield strength of the reinforcing bar anchor})$.
- Equip anchor bolts with three nuts above the top of the concrete: two to secure, one to level.

3.16.9 Demolition of Structures and Foundations:
Any existing foundations to be demolished shall be removed to a six-foot depth unless a deeper foundation is required. Existing foundations interfering with new foundations shall be removed entirely. Design drawings of PG&E will indicate any portions of foundations remaining.

3.16.10 Site Development:

3.16.10.1 Scope: Contractor shall provide design for site grading, paving, roads, drainage, and spill retention facilities for the Project per PG&E's Design Criteria memorandum DCM 073101 (Document No. 77 from Table 1), DCM 073102 (Document 78 from Table 1), and DCM C-1.3 (Document 79 from Table 1).

3.16.10.2 Yard Surface: Contractor shall be responsible for the yard surface

design based on the grounding study (See Document 1P from Table 1).

3.16.10.3 Access Road: Where access roads are specified to be provided, they shall be designed in accordance with DCM 073101 (Document No. 77 from Table 1), and shall also include a gate to obtain access to the Substation.

3.16.10.4 Site Layout: Substation yard layout shall show the locations of all structures and foundations, fences and gates, roads, and any additional spaces required during the Substation construction phase.

Spill Prevention Control and Countermeasure (SPCC) features shall conform to DCM C-1.3 (Document No. 79 from Table 1) and DCM E-1.5 (Document No. 66 from Table 1). Facility improvements shall use concrete or shotcrete for features including curbs, dikes, berms, retaining walls, sumps, basins, and weirs.

3.16.10.5 Geotechnical Investigation: Contractor shall evaluate site subsurface conditions to prepare geotechnical and grading design criteria for use in foundation design. Contractor shall conduct Work required to provide adequate subsurface information for geotechnical aspects of Project design and construction and present the information in a geotechnical report. Contractor shall provide geotechnical investigation request form (Document No. 108 from Table 1) to PG&E Geoscience Department before geotechnical investigation.

3.16.10.6 Generally, geotechnical reports shall have the essential information (See Document No. 108 from Table 1). Copies of all geotechnical reports (stamped and sealed by a California registered P.E.) shall be furnished to PG&E Substation Civil Engineering and PG&E Geotechnical Department. Reports shall be submitted in electronic PDF Format. GPS locations (Latitude and Longitude) shall be given for all borings. Geotechnical Information and Reports developed for soils within PG&E property may be copied and distributed by PG&E for information purposes necessary at the discretion of PG&E.

3.16.10.7 For Geotechnical Drill Cuttings Management and Disposal Guide see Document No. 108A from Table 1.

3.16.11 Battery Building - If required, provide a battery building in accordance with PG&E Drawings 4018144 & 392693 (Documents Nos. 95 & 96 from Table 1). The maximum allowable width of the building shall be limited to 15 feet-4 inches to facilitate shipment on California Highways. The Building shall be complete with all required structural features, HVAC System, fire detection systems, electrical raceways, hydrogen detection system, etc. as indicated in these Specific Conditions. To the extent applicable, the following features shall be considered for inclusion in the design of the building.

3.16.11.1 The following are the PG&E approved suppliers for the battery building:

- Trachte, 422 North Burr Oak Ave, Oregon, WI 53575, (608 835 5707)
- Olson Wagner Construction, Inc. Clovis, CA 93612 (Tel. 559 299-9328)

3.16.12 The loading of the building shall be per - Steel Structures, Equipment Anchorage and Foundations (DCM 073102) (Document 78 from Table 1). All drawing required for obtaining local permitting shall be signed and stamped by a California-registered Civil or Structural Engineer. Electrical floor plans, drawings and calculations shall be furnished along with the relevant sections and elevations. Structural calculations shall include the following:

- Determination of design loadings and load combinations
- Identification of the load paths for lateral and vertical loads.
- Evaluation of critical members
- Evaluation of critical connections

- ICC Evaluation Reports supporting the shear panel design and anchorage systems used.

3.16.13 The building shall be designed using an importance factor shown on Document 78 from Table 1. Roof structure shall be designed to support a vertical-tee cable tray system. Battery racks shall be mounted directly to floor joists – not just to floor sheeting unless proven structurally adequate.

3.16.14 Both end and the high sidewalls, gutters, roofs, ceilings, louvers, fire protection system shall be constructed per PG&E Battery Building specifications (Documents 95 & 96 from Table 1).

3.16.15 Openings in structural panels and members shall be considered in the design. Carry out analyses whenever required and openings shall be reinforced, or alternative mechanisms of resistance (such as bracing) shall be provided.

3.16.16 Adequate ventilation shall be provided between the foundation slab and flooring to prevent trapped moisture or condensation buildup.

3.16.17 Building shall be designed in conformance to 2010 California Fire Code and the following requirements:

3.16.18 Fire Suppression:

The battery building shall be provided with an automatic fire suppression consisting of an FM 200 clean agent total flooding system (or equivalent). CO2 is not considered an acceptable equivalent because of life safety considerations.

This fire suppression system shall be sized/designed to automatically discharge the extinguishing agent. Actuation of the system will be via the smoke detection system (see Paragraph C.3.13.7.2 below). The ventilation system must be interlocked with the suppression system so that the fans are shut down and the dampers closed prior to discharge of the agent.

3.16.19 Smoke Detection:

A Notifier 2451 (or equivalent) smoke detector shall be provided. The detectors are to be used in conjunction with the Notifier RP-1002 (or equivalent) fire alarm panel. (This panel is capable of accommodating the fire suppression system if required.). The signals from the fire alarm panel shall be capable to be monitored at an approved Central Station Service.

3.16.20 Building Construction

Building construction shall be of noncombustible construction. If located closer than 50 feet from energized oil filled equipment the exposed wall of the building shall have a fire rating of two (2) hours.

3.16.21 Barriers/Penetration Seals:

With the automatic fire extinguishing system, all openings to the exterior must be sealed to prevent leakage of the extinguishing agent upon discharge. Also, dampers in the louvered openings to the exterior must be provided to minimize leakage, and interlocked with the fire suppression system to close prior to discharge of the extinguishing agent. See Documents 97 and 97A from Table 1 for Penetration Seal Details.

3.16.22 Portable Extinguishers:

Portable extinguishers shall be provided for the building, installed in accordance with NFPA 10, "Portable Fire Extinguishers", as follows:

A multipurpose dry chemical extinguisher located near the exterior door with a minimum Class 2-A: 40-B: C rating. Contractor shall maintain Portable Fire Extinguishers as required until the building is turned over to PG&E.

3.16.23 Power Line Carrier and wave traps

3.16.24 Design details to install wave trap, and structures, per EDS Dwg'375494

(Document No. 65 from Table 1), each for mounting the wave trap, coupling capacitor, and line tuner.

3.16.25 Install foundations for wave trap structures for mounting the wave trap, coupling capacitor, and line tuner cabinet per Document No. 78 from Table 1, CDS Dwg 330006, (Document No. 65 from Table 1), and EDS Dwg 459983, (Document No. 17 from Table 1).

3.17 SEISMIC REQUIREMENTS

3.17.1 General: The equipment, accessories, supports, and foundations for yard equipment and structures shall be designed such that there will be no damage nor loss of function and the equipment will remain operational during and following the seismic event. The term "operational" implies that rotating equipment will not freeze, pressure vessels will not rupture, supports will not collapse, systems required to be leak tight will remain leak tight, and components required to respond actively (such as control linkages, switch contacts, relays, motors, pumps, etc.) will respond actively. In addition, equipment shall not be caused to change operative state due to the seismic event (for example, a circuit breaker in an open position shall remain open; if closed, it must remain closed). Requirements for the design of support structures, foundations and anchorages are specified in this Section C.

3.17.2 Substation equipment shall be seismically qualified in accordance with the requirements of Document 78 from Table 1, and IEEE 693. Requirements for qualification reports, calculations, outline drawings, and other documentation are specified in the referenced standard. Unless otherwise specified by PG&E, all equipment shall meet the HIGH seismic qualification level specified in IEEE 693, and as described below:

3.17.3 Support structures shall satisfy the conditions of the seismic qualification of equipment mounted upon it.

3.17.4 Equipment supported at above-ground levels of a building or enclosure structure shall be seismically qualified for amplified input motions determined by a method approved by PG&E.

3.17.5 Frequency-modifying devices shall not be allowed without the approval of PG&E.

3.17.6 New equipment may be installed on existing structures if the following conditions are satisfied;

- PG&E approves such use.
- Existing structure is capable of resisting statically applied or sustained loads in accordance to Document 78 from Table 1.
- Structural elements whose function is to attach and transfer seismic loads required by the CWA or this Contract shall conform to Document 78 from Table 1.
- The existing structure satisfies the seismic qualification/ design requirements for the equipment being supported in accordance with Document No. 78 from Table 1.

3.17.7 Structures and components not requiring IEEE 693 seismic qualifications shall be designed in accordance to Document 78 from Table 1.

3.17.8 Seismic design of foundations and anchorages shall be in accordance to Document 78 from Table 1.

3.17.9 PG&E's review of the analysis or test shall not relieve Contractor of the responsibility for providing equipment and supporting structures that can withstand the required seismic loads.

3.17.10 The Contractor shall submit engineering calculations used for the design of structures,

foundations, and anchorages to PG&E for Acceptance. Documentation shall be stamped and signed by a California registered Civil or Structural Engineer.

3.17.11 Seismic qualification reports for equipment shall be stamped and signed by a California registered Civil or Structural Engineer or approved alternate. The approved alternate is a registered professional engineer who, in the opinion of PG&E, has demonstrated an understanding of structural dynamics and analysis. Although the approved alternate need not be registered in California, a professional engineering registration in a state is required.

3.17.12 Contractor shall provide a seismic letter of compliance certifying conformance with the seismic requirements in the CWA or this Contract. The letter shall be signed by an authorized representative of the manufacturer and a registered professional engineer.

3.18 DESIGN - DRAFTING REQUIREMENTS:

3.18.1 All drawings for construction shall be prepared on PG&E drawing format, using PG&E drafting practices as described in the applicable sections of PG&E Substation Electrical Design Guideline Manual. A copy of the manual will be loaned to Contractor for his use while preparing the construction drawings. See Document 47 from Table 1 for Graphic Symbols for Electrical Diagrams.

3.18.2 Drawing sizes and title blocks shall be in accordance with PG&E Standard Drawing No. 504848 (Document 48 from Table 1), except that the "Approved" block shall be retitled to read "Accepted." Contractor shall be identified by name in some manner adjacent to the standard title block.

3.18.3 Contractor shall request from PG&E a block of drawing numbers after the quantity and sizes of required drawings has been determined. Contractor shall then submit a drawing list to PG&E for retrieving electronic drawings to be used for the project.

3.18.4 As a minimum, Contractor shall prepare the following drawings:

- Main single-line diagram
- General arrangement outdoors
- General arrangement indoors
- Arrangement of foundations
- Foundation Data Sheets
- Grading Plan
- Structural drawings and calculations
- Structure requirements
- Site plans
- Arrangement of conduits outdoors
- Arrangement of grounds outdoors
- Equipment arrangements
- Overlay of equipment arrangement and foundation arrangement
- Lighting layout
- Switchboard arrangements
- Bill of Material for all Outdoor and Indoor Arrangement Drawings
- Single line meter and relay diagram
- Schematic diagrams
- Interconnection, block and/or cabling diagrams

- Conduit and Tray Schedule
- Circuit schedule (point to point type)
- Drawing list
- As-built drawings

3.18.5 All drawings for construction shall be approved and stamped by Contractor's California registered engineer as the engineer on record. The Contractor's Professional Engineer's stamp shall appear on all electronic copies of the drawings. The registered engineer shall sign on the hard-copy prints submitted for construction and installation.

3.18.6 All new drawings shall be computer generated and shall be compatible with the Intergraph system of computer aided design (CAD). The Contractor shall submit, in digital form, all construction and installation drawings. The format shall be as specified in Document 69 from Table 1.

3.18.7 Non-drawing documents such as bill of materials, circuit schedules, conduit schedules, etc. shall be compatible with Microsoft software (EXCEL, WORD, ACCESS, etc.). PG&E will furnish templates for such documents.

3.18.8 Bill of Material shall be prepared with the Material Database ACCESS program provided by PG&E (Section 2.19 of the PG&E Substation Electrical Design Guidelines). Coded materials (with 6 digit PG&E codes) shall be used in all designs. If non-coded material is used (use only when coded material is not available) detailed information such as ratings, physical dimensions, weight, materials used, manufacturer catalog number, applicable industry standards, etc. shall be specified.

3.18.9 Bill of Materials shall show the break-down by tasks.

3.18.10 Conduit and Circuit Schedules shall be complete with type of wires, wire ID's, and point-point connections, etc. Conduit shall identify all circuits routed in it.

3.18.11 Contact development for control switches and relays shall be complete and properly referenced if shown on other drawings.

3.18.12 Contractor shall prepare and issue all drawing using PG&E approved transmittals. PG&E will provide a blank copy for use. Contractor shall use PG&E Design Guideline in preparing transmittals.

3.19 EQUIPMENT MAINTENANCE

3.19.1 MAINTENANCE: Maintenance responsibility shall pass to PG&E upon written Acceptance of the system for operation. However, this does not relieve the Contractor of any other responsibilities as set forth in this Contract.

4 SUBSTATION TESTING AND JOB CLOSEOUT

4.1 TESTS:

4.1.1 General: The Contractor shall be responsible for compliance with all standard test procedures which shall progressively check the quality and performance of the equipment. All equipment included in this Contract shall be tested before being placed in service and shall meet the requirements of the Engineering Procurement and Construction, Contractors Requirements, Outline of Installations Test Procedures for Substations (Document 72 from Table 1, Test Document Folder). Contractor shall furnish the test procedures (forms provided by PG&E), the test instrument, and qualified personnel required to perform all required testing including HV

phasing, and relay testing. The calibration records of the test equipment and torque wrenches shall also be provided for PG&E approval. Contractor shall adhere to all test requirements and the accompanying documentation as delineated in the Test Book. All test results shall be documented on the PG&E test forms listed in the Test Forms (Document 72 from Table 1). For equipment covered in the Project scope and for which forms are not available, the Contractor shall submit these forms for PG&E Inspector's approval prior to commencement of testing. There shall be no exceptions unless previously approved in writing by the assigned PG&E Test Supervisor. Contractor shall provide a hard copy of the test results as well as an electronic copy on a CD in accordance with Document 72 from Table 1. Prior to commencement of these tests all test equipment shall have been calibrated within the last twelve (12) months prior to its use on the Project. Calibration test results obtained from a recognized and certified calibration lab is to be supplied to the PG&E Test Supervisor or their designated representative for each piece of test equipment used on the Project.

4.1.2 Contractor shall perform those design, production and commissioning tests specified below and in other sections of these Specific Conditions or the CWA. The Contractor shall propose additional tests which will be conducted. Where appropriate, tests will conform to those contained in ANSI, NEMA and IEEE standards and guides. Where standards are not suitable or applicable, other common industry procedures and mutually acceptable methods shall be used.

4.1.3 If certain design, production or commissioning tests are performed by manufacturers or others, the Contractor has the responsibility to give PG&E prior notice and to furnish the test reports and certify that the necessary testing has been performed. For all design, production and commissioning tests the following rules shall apply:

4.1.3.1 PG&E reserves the right for itself and/or its representatives to be present and witness all tests. PG&E requires two (2) week notification prior to initiation of any Acceptance testing.

4.1.3.2 The results obtained must demonstrate that the equipment and systems conform to the requirements of the CWA and this Contract.

4.1.3.3 Contractor, at all times, must obtain permission from PG&E upon thirty (30) calendar days' notice (an ISO requirement) to PG&E to perform tests when the system is connected to PG&E's electrical power system. The tests must be performed to minimize unanticipated interruptions to the power system. These tests may have to be performed during the low load periods. Low load periods are defined as nights, weekends, fall and winter seasons as may be deemed appropriate by PG&E.

4.1.3.4 If parts fail or are replaced during testing, a full written description and explanation shall be provided to PG&E.

4.1.3.5 If any piece of equipment provided as part of the system does not pass a test or is damaged, the Contractor must immediately replace or repair the failed or damaged equipment and modify the equipment design, if applicable, so as to minimize the possibility of further failure. The Contractor shall perform on repaired or replaced equipment the tests previously performed on any equipment or assembly, which is to be replaced, repaired or modified. All expenses for the material, removal, re-installation and re-testing will be the responsibility of the Contractor.

4.1.3.6 PG&E will participate in factory inspections of equipment, including but not limited to, Circuit Breakers, Disconnect Switches, CCVTs, Steel Structures, Bus Material and conductors, insulated cables, relay panels, Station Post Insulators, etc. purchased by the Contractor, unless waived in writing by PG&E. Contractor shall provide PG&E advance notice of equipment and material inspections to allow time for PG&E inspection participation.

4.1.3.7 Factory inspection of equipment purchased by Contractor for PG&E projects and by third party, interconnection projects (Third Party) that will be deeded to PG&E shall be at the discretion of PG&E. Inspections shall be conducted by PG&E Supplier Quality Control (SQC) group. Contractor and Third Party shall inform manufacturer when issuing a purchase order (PO) to the manufacturer that PG&E may contact the manufacturer to arrange for inspection of equipment that will become the property of PG&E. Inspection costs as agreed between the manufacturer and PG&E shall be paid by PG&E for Contractor projects and Third Party for equipment deeded to PG&E.

4.1.3.8 Contractor and Third Party shall provide PG&E's SQC with a copy of the PO (supplier to determine if amount of purchase to be blocked out), the name, address and the telephone of the manufacturer of the equipment so PG&E's SQC can coordinate inspection with manufacturer. Contractor and Third Party shall require on the purchase order that the equipment manufacturer give five (5) working days or ten (10) working days for equipment manufactured outside North America, advance notice of any tests or preparation of shipment, and such notice shall be addressed to PG&E's Supplier Quality Control. Contractor and Third Party shall provide PG&E up to ten (10) business days per factory visit without penalty for shipment delay as a result of scheduling QA inspection. PG&E shall not be held responsible for any lost time in shipment from modifications or corrections to the equipment related to inspection.

4.1.4 Protection, Automation and Control Test Requirements for MPAC Buildings.

4.1.5 Thirty (30) calendar days prior to performing the Factory Quality Check (FQC), the MPAC Manufacturer/Vendor shall request the following:

4.1.5.1 PB/LED templates from PG&E

4.1.5.2 Generic Relay Settings Files from PG&E

4.1.5.3 IP/DNP Address Assignment forms from PG&E

4.1.5.4 Vendor shall notify RTSCAD contractor of scheduled work. The FQC shall be used by MPAC Manufacturer for product quality validation and will be administered in lieu of the Factory Acceptance Test. For FQC test requirements see Document No. 94C from Table 1.

4.1.6 A Building Acceptance Test (BAT) is required once the MPAC building is at the site. Test results shall indicate a PASS, FAIL or N/A (Not Applicable). Test shall include the Initial Inspection of the building, AC & DC Power Systems, Internal Building Equipment Layout Inspection, HVAC Equipment, Fire Detection System and Switchrack Equipment. Refer to Document No. 94C from Table 1 for test forms.

4.1.7 Site Acceptance Test (SAT) shall be performed after the Building Acceptance Test (BAT) has been completed. For SAT test forms see Document No. 94C from Table 1. The procedures shall facilitate the testing of the Control and Protection Equipment and configuration. The Test Procedures shall be comprehensive and shall include the following:

4.1.8 Equipment for interconnecting the IED (intelligent electronic devices) and interface to other locations.

4.1.9 All Protection Switchrack; (line, transformer, breaker, bus protection, SPS, RAS, digital fault recorder, etc.)

4.1.10 All Automation and Communication Switchrack; (HMI and communication rack).

4.1.11 The scope of testing shall be limited to the equipment and wiring within the Switchrack panels. External equipment such as circuit breakers and status points shall be simulated by auxiliary relays or switch contacts where required to facilitate testing of the various schemes and shall cover, as a minimum, but not limited to the following:

Communication Testing

Verifying the devices are communicating.

- Verifying the HMI or RT SCADA Master Station correctly reads values from IEDs.
- Verifying the HMI or RT SCADA Master Station correctly issues SCADA controls.
- Verifying the Time Synchronization of IEDs with IRIG-B and/or NTP.

Current Circuit Testing

- Continuity Testing.
- Confirming single point grounding.
- Verifying the proper polarity of all elements (relay and metering) in the circuit.
- Verifying the CT secondary circuit is correct per the schematic.
- Potential Transformer Testing
- Verifying the phasing, polarity, and continuity of all associated potential circuits.
- Confirming single-point grounding.
- Verifying the proper polarity of all elements (relay and metering) in the circuit.
- Verifying the PT secondary circuit is correct per the schematic.
- Protective Relay Testing (Including Auxiliary Relays and Timers)

Protective Relay testing

- Recording the nameplate data.
- Setting the relays per the relay setting files.
- Performing an operational check to verify the proper trips/interlocks/alarms per schematic diagrams.
- Functionally testing each configured element and verifying that the appropriate output is obtained.
- Verifying the correct target is actuated.
- Operating the end device (Auxiliary relay, CB simulator, CB, etc.) at least once for each output.
- Setting and measuring the timer settings (part of logics).
- After completion of all testing, save the relay settings and verifying this agrees with the applied settings and provide appropriate electronic files for the as-left relay settings.
- Coordinating with the SCADA system testing to verify controls

4.1.12 Testing Sequence

- Control Wiring Verification (point to point).
- Schematic as each circuit segment is verified.
- Control power startup sequence. (Verify each segment of the DC circuit will apply the correct voltage to the equipment before energizing. Apply voltage and verify equipment startup is successful.)
- Record equipment nameplate and serial number data on the test sheets. Check that correct firmware is installed. Upload approved settings to the device.

- Establish communications between IEDs, HMI, LAN, etc. This may require setting IP addresses and communication parameters to temporary values if final settings are not available.
- AC circuit tests. Apply 1 amp at the instrument transformer end of each current circuit and verify the circuit from point to point. Confirm that polarity at each device or test switch is consistent with the schematics. Verify that all shorting devices operate and will not allow the CT to be open circuited. Measure the voltage required to circulate 1Amp with all devices connected. Apply AC voltage (nominal or less) at the terminals where the VT's will be connected. Verify proper voltage and phase at each test switch and device.
- Apply nominal AC voltage and current and verify that the relay or device indicates the correct values.
- Functional Tests. Connect a CB simulator to simulate external equipment operation of the scheme being tested. Apply voltages, currents and configurations to simulate various normal and abnormal system conditions listed for each scheme. Record the response on the appropriate electronic form and compare to expected results.

4.1.13 Installation and Test Report: Contractor shall submit a Master Inspection and Test Report (ITR) to PG&E as specified in Section 2.0 Quantity of Submittals of Document No. 69 from Table 1 (Submittals for EPC Contracts after award). A detailed Master Inspection and Test plan shall be submitted to PG&E as specified in Documents Nos. 69 and 72 from Table 1 (Requirements for Electrical Testing of Substation Equipment During Construction and Commissioning), as attached to the specification, including the criteria for pass/fail in the specifying documents, e.g., instruction books or commissioning manuals. The ITR submitted to PG&E by Contractor shall include both Commissioning tests and Functional Tests including but not limited to:

4.1.14 Commissioning Tests: The commissioning tests are those tests to be performed at the site when the external equipment is out of service. The tests shall include but not be limited to:

4.1.14.1 Checkout Tests: The following tests shall be performed:

4.1.14.2 Alignment and adjustment of all disconnect switches.

4.1.14.3 Wire Insulation (Megger) test all control cables.

4.1.14.4 Power factor testing shall use Doble test equipment. Contractor to provide additional Test Report in Electronic form including Doble XML files to Inspector on site and PG&E's ATS group as shown on the address below:

PG&E
Applied Technology Services
3400 Crow Canyon Road
San Ramon, CA. 94583
Attn: Fred Skillman
Email: FRS1@pge.com
Tel (925) 866-5514

4.1.14.5 Calibration of all gauges, meters and instruments.

4.1.14.6 Check operation of all circuit breakers and measure contact resistance and adjust travel time (open and close) on each pole.

4.1.14.7 Continuity test of all wiring in strict accordance with ANSI C37-20-5.3.4.1, Method No. 2, which is performed from terminal to terminal progressively rather than from end to end of circuit.

4.1.14.8 Measure grounding system resistance using the Fall of Potential Method. If contractor cannot perform this task inform PG&E's Project Manager and Inspector on site to have this done by PG&E's ATS group as shown on the address below:

PG&E
Applied Technology Services
3400 Crow Road
San Ramon, CA. 94583
Attn: Fred Skillman
Email: FRS1@pge.com
Tel (925) 866-5514

4.1.14.9 Calibrate and test relays.

4.1.14.10 Proving Insulation- For any megger tests referred to below a 2,500 volt DC Megger or a hi-pot is preferred, but a 1,000 Volt DC megger is acceptable.

- All Circuit breakers must be meggered in the following manner:
 - Breaker-open-each pole to ground, pole 1-2, pole 3-4, pole 5-6.
 - Breaker closed-pole 1-ground, pole 3-ground, pole 5-ground and if the poles are in common tank or cell, pole 1-3, pole 3-5, pole 5-1.
- All buses and cables shall be meggered phase-to phase and phase-to-ground.

4.1.14.11 Circuit Breakers

- A minimum to trip at seventy (70) percent or less of the nominal DC control voltage must be performed on all circuit breakers.
- A Micro-ohm test must be performed on all circuits
- A timing test showing the time from trip initiation to main poles closing is required.
- A timing test showing the time from close initiation to main poles closing is required.
- The dress and test requirements are the responsibility of the Contractor and shall meet the requirements of Document No 72 from Table 1. All HV breakers, SF6 breakers shall be tested for all the tests listed in this Section D as applicable including the ones mentioned in Document No. 72 from Table 1. These include, but are not limited to: power factor, megger, and gas moisture tests on breakers as well as on SF-6 Bottles. The moisture test results shall be provided to the PG&E Onsite Inspector, in writing, prior to filling the breakers with gas.

4.1.14.12 Current Transformers and Current Circuits

- A saturation check shall be made on all current transformers (CTs). If this is not possible, a manufacturer's curve is acceptable.
- The ratio of all CTs must be proven either by using current (primary to secondary) or voltage (secondary to primary).
- CT circuits must be checked for proper connections and continuity by applying primary or secondary current and reading in the relays. Each test (primary or secondary) must be performed in all combinations to prove proper connections to all phase and ground relays. Current must be applied or injected to achieve a secondary reading of 5 amps in each relay to ensure that no loose wiring or parallel current paths exists.
- A single-phase burden check must be made on each phase of each current circuit.
- A megger check of the total circuit with the ground wire lifted must be done to

prove that only one ground exists.

4.1.14.13 Relays

- All relays must be functionally field tested on site to their specified settings to verify the proper operation.
- This includes the following for electro-mechanical and solid-state devices:
- Minimum operating point at which the relay picks up.
- Time delay at three different current test points, in integral multiples of minimum pickup that closely characterize the relay time-current curve.
- Phase angle characteristic of directional relay.
- Pickup points at maximum torque angle (MTA) and ± 30 degrees of MTA on impedance relays using the approved settings.
- Slip frequency, voltage matching, phase angle acceptance and breaker compensation time on synchronizing relays.

4.1.14.14 PG&E tolerances are listed below

- Current/Voltage/Time ± 10 percent
- Impedance/Phase Angle ± 0.05
- Frequency ± 0.05 Hz. Microprocessor devices will be functionally tested utilizing system simulated fault conditions.
- Transformers
- The Contractor shall be responsible for ALL functional testing of the existing transformers connected to the bus (run the pumps, fans and controls, etc.) as well as completion of ALL wiring necessary to prepare the transformer for bank paralleling, interface connections and final test program and release. This shall include, but not be limited to: installation of any wiring and/or all jumpers in the transformer control cabinet as required by the Contractor's design, transformer specification, transformer manufacturer's schematics (certified and issued for Contractor by PG&E) and PG&E protection and control standards. The Contractor shall co-ordinate and ensures that all protection, measurement, control, communication, and SCADA interface devices are tested and their functional application is in accordance with the approved design documentation. Any corrections and/or adjustments to the wiring scheme required to fully implement the accepted PG&E design shall be included as part of Contractor's Work scope. In addition to meeting the requirements of the CWA and this Contract, the Contractor shall submit a comprehensive program in this regard for PG&E's approval to better define its scope activities included in its test plan as part of its Proposal, which shall include activities such as: testing of all bushing current transformers furnished with the transformer in accordance with ANSI C57.13.1 including their saturation test, all thermal relays and temperature indicating devices, all pressure and/or flow tripping devices, and tap changer controller settings and integrated operation of the tap changer's responses to the controller, timing tests of changer movements for each step and throughout its entire range in accordance with instruction manuals of the tap changer & tap changer controller.

4.1.14.15 Shielded Wire All shielded wire installation, termination, and testing shall be in accordance with the PG&E standards either for all Contractor installed wiring. Where shielded wiring is furnished as part of any equipment covered in the scope of this Contract, Contractor shall also perform testing of the shielded wire (e.g. shielded wiring provided for sudden pressure relays in transformer). Any deviation from these standards shall not be permitted unless approved in writing by the Responsible Engineer for the Project.

4.1.14.16 In addition to the tests listed above, the Contractor shall specify any additional

checkout tests necessary for the complete operation of the equipment being installed. PG&E can request additional test as necessary if any abnormalities or discrepancies are discovered during testing or if additional test are required to make the transformer banks including all installed equipment and systems complete and fully operational. All abnormalities or discrepancies will be reviewed and corrected before placing equipment in service.

4.1.14.16.1 Functional Tests: After completing the checkout test with satisfactory results, functional tests shall be performed. The purpose of the functional test is to verify the proper sequential operation (trip test) of the protection control systems and any other control system.

The Contractor is responsible for ensuring that all relays and other protective devices are adjusted and working properly prior to the functional tests. If problems arise with equipment during testing, the PG&E protection representative may elect to cancel the test and reschedule.

Functional tests shall be performed by contractor and all tests shall be observed by PG&E's substation test supervisor or his/her representative. Contractor shall provide all test equipment and qualified personnel to perform the required tests.

These tests shall include:

4.1.14.16.2 Sequential testing in accordance with ANSI C37.20-5.3.44, shall ascertain that all instruments, relays and devices are functionally operable and in sequence as outlined by the elementary diagrams.

4.1.14.16.3 System performance.

4.1.14.16.3.1 The Contractor shall define other functional tests, which will be performed PG&E elects.

4.1.14.16.4 On-line System Commissioning Tests: Upon satisfactory completion of the facility commissioning tests by Contractor, on-line system commissioning tests shall be performed by PG&E. On line commissioning test are those test performed at the site on the fully assembled facility connecting the new installed equipment and systems to the energized bus. It is the expectation of PG&E that all new installed equipment and systems as specified in the specification are safely installed, tested and operational to the satisfaction of PG&E. PG&E will require 10 days' notice prior to any test requiring line clearance. These tests will be conducted during low load periods, such as nights, weekends, and fall or winter seasons. Upon successful completion of PG&E's test program and correction of all deficiencies identified, PG&E will accept the facility for operation.

4.2 REQUIREMENTS FOR ENERGIZING PG&E SUBSTATION EQUIPMENT

Requirements for energizing PG&E substation equipment shall be in accordance with Document 72 from Table 1. PG&E shall be responsible for determining applicability of items and responsibility on the checklist sheet. The checklist will be reviewed during the pre-energization walk through review.

4.3 TRAINING

Contractor shall be responsible for scheduling the required operations and maintenance training for new equipment being installed that is first of each kind in the facility or maintenance supervisor's area of responsibility. Contractor to get concurrence from PG&E's Maintenance and Operations supervisor for duration of training, attendance and other requirements.

4.4 EQUIPMENT FORMS

Contractor shall be responsible for completing the basic information regarding new equipment being installed. Contractor shall copy equipment nameplate and other data required in the PG&E provided Substation Asset Equipment forms and submit electronic copies to PG&E Inspector on site. Refer to Document No. 111 from Table 1, for PG&E Equipment Forms.

4.5 EQUIPMENT BEING RETIRED

Contractor shall be responsible for completing the necessary forms required for retiring assets that had been removed or replaced during construction. See Document No. 70 from Table 1 for Retired Equipment Forms and submit electronic copies of completed forms to PG&E Inspector on site. In addition, contractor shall complete the Property Settlement forms as shown on Document No. 111 from Table 1. For Replacement cost, the present installed cost can be used. For year when equipment was first installed, refer to bill of materials or equipment arrangement drawings.

4.6 AS - BUILT DRAWINGS

4.6.1 Unless specified otherwise in CWA, Contractor shall submit as-built drawings to reflect the actual conditions as installed and tested. All drawings, including without limitation existing PG&E drawings, shall be revised and submitted to PG&E, per Documents Nos. 69 & 80 from Table 1.

4.6.2 PG&E will provide existing PG&E drawings to Contractor. Contractor shall be responsible for identifying affected PG&E drawings.

4.6.3 Contractor shall provide the following:

- One set of full size prints.
- Drawings in digital format shall be submitted after PG&E signs and dates all drawings for the project.

5 OVERHEAD TRANSMISSION LINE CONSTRUCTION REQUIREMENTS

5.1 GENERAL REQUIREMENTS

5.1.1 GENERAL WORK REQUIREMENTS: Principal types of Work Contractor shall perform as requested in a CWA may include, but is not limited to:

a) Structures: Work shall include the repair, assembly, fabrication and erection of steel towers, tower extensions, poles and other types of structures as required in the CWA.

b) Insulators: Work shall include the installation, replacement or relocation of insulators and required hardware to the cross arms and cage tops.

c) Conductors: Work shall include the stringing, relocation, sagging, tensioning, splicing, clipping-in and attachment of the conductor and shall be specified in the CWA.

d) Civil: Work shall include Civil Work as required in the performance of the CWA and includes construction of footings, foundations, trenching, grading, installation of conduit and other Civil Work.

e) Contractor shall obtain all necessary permits needed to perform the work. Excluded are permits required from the California Public Utility Commission, US Fish and Wildlife, Army Corp of Engineers, California Department of Fish and Game, Cal-Trans and Union Pacific Railroad.

f) Contractor shall be responsible for minor tree trimming or brush removal necessary for the Contractor to perform the Work. Contractor shall coordinate any tree trimming or brush removal with property owners and PG&E Inspector prior to performing work. Contractor shall notify PG&E Inspector at least five working days prior to the planned work date at sites requiring tree trimming or brush removal. PG&E is not responsible for Contractor's delay if such notice is not provided.

5.2 UNDERGROUND SERVICE ALERT:

5.2.1 Contractor is responsible for ensuring that the Work area is properly marked with white paint and for contacting Underground Service Alert (USA) in accordance with USA's requirements.

5.2.2 The following summary of USA procedures is provided for Contractor's convenience, but PG&E has no responsibility for its accuracy or completeness. Contractor must contact USA (phone 1-800-227-2600, Monday through Friday, 6:00 am - 7:00 pm) at least 2 full working days and not more than 14 calendar days prior to digging holes or installing anchors. For USA purposes only, a "working day" is defined as Monday through Friday, 7:00 am - 5:00 pm, national holidays excluded. USA phone bank hours are longer than and are distinct and separate from, USA's working day hours. A USA ticket is valid for 14 calendar days.

5.2.3 Since USA does not contact private property owners, Contractor shall contact private property owners prior to digging holes or installing anchors on private property to verify the location of privately-owned underground facilities such as gas lines, water lines, etc. and to coordinate the Work with the property owners.

5.3 PG&E PROPERTY ACCESS:

5.3.1 Contractor shall not enter any PG&E property or other PG&E facility, except in the presence of the PG&E Inspector or with written permission.

5.4 SAFE PERFORMANCE OF THE WORK:

5.4.1 Contractor shall bear the cost of furnishing all watchmen, signals, etc. necessary for the proper and safe performance of the Work. All gates found closed must be kept closed except for passage of vehicles and personnel. Contractor shall not release fenced livestock and shall not alarm livestock and fowl.

5.4.2 **ADDITIONAL PRECAUTIONS:** If the PG&E Inspector requests Contractor to provide certain safeguards not in use but considered necessary and if Contractor fails to comply with the request within a reasonable time, PG&E may provide the safeguards at Contractor's expense. Failure to comply with safety precautions required by the PG&E Inspector may result in termination of the Contract as described in the General Conditions Article B.21 (Cancellation and Termination of Contract) of the Construction General Conditions.

5.4.3 HAZARDS:

Hazards may include, but not limited to, clearance procedures, climbing new and old wood poles, energized electrical facilities, high tension cables and wires, underground/overhead utilities, overhead obstructions, helicopter access, aerial lifts, excavations, confined spaces, live gas facilities, chemicals, pesticides, PCB, lead, hazardous materials, emergency conditions, weather conditions, heat illness, noise, vehicular and pedestrian traffic, bees, wasps, snakes, spiders, poison oak/ivy and driving are present for this Work and personal protective equipment, an emergency action plan/communications, safety at height, hazardous waste management and driving are required for this Work. Contractor shall take all precautions necessary to protect all persons (employees of Contractor and PG&E and third parties, including members of the public) and property (of Contractor, PG&E and third parties) from exposure to these risks. At a minimum, Contractor must comply with all federal, state, local or any other regulations that apply to the Work.

FIRE HAZARDS: Contractor shall provide appropriate fire safeguards by keeping worksite and its immediate surrounding free of dry brush, weeds, grass, debris and other conditions which may cause fire hazards.

5.4.4 **BARRICADES:** Contractor shall adequately protect spoil, waste material and debris left overnight with barricades equipped with operating flasher lights and/or reflective tape to safeguard all persons and persons and property from injury.

5.4.5 **FIRE REGULATIONS:** Contractor shall comply with the requirements of the California State Division of Forestry Fire Prevention Bureau and the regulations of the Public Resources Code, Section 4167 which governs the use of spark arrester devices on all motorized equipment.

5.4.6 **NOISE CONTROL:** Contractor shall provide noise control for equipment which will be operating for extended periods of time or during the night.

5.4.7 **OPERATION OF SWITCHES:** Contractor shall not open or close any switches on energized equipment. Contractor will be instructed in the method of PG&E tagging and clearances procedures.

5.4.8 **SIGNS:** Contractor shall provide and install street project signs in accordance with the appropriate regulatory agency's permit.

5.4.8.1 Contractor shall post "No Parking" and other traffic control signs; place barricades, K-rails, lights, cones, flares and reflectors as needed; utilize flagmen; utilize shoring and bracing; install steel plates at major street crossings and at the other locations required by good safety practices and/or jurisdictional agencies.

5.4.9 **TEMPORARY FENCES AND BARRICADES:** Contractor shall provide and maintain all temporary fences and barricades as required for the Work and to safeguard construction materials. When appropriate, barricades equipped with operating flasher lights and/or reflectorized tapes shall be utilized to safeguard all persons and property from injury. Contractor shall remove the above temporary fences and barricades upon the completion of the Work.

5.4.9.1 Barriers: Contractor shall provide and maintain until completion of the Work sufficient barriers, platforms and other safeguards as necessary. Any open augured holes shall be covered at all times with plywood having a minimum thickness of $\frac{3}{4}$ ".

5.4.10 **TRAFFIC CONTROL:** Contractor shall take all necessary precautions for the protection of the Work and the safety of the public. Public roads closed to traffic for the Work shall be protected by the use of qualified flagmen and/or installing effective barricades with proper warning and detour signs attached.

5.4.10.1 Contractor shall bear the cost of furnishing all labor (i.e., watchman, flagger, etc.), signals, etc. necessary for the proper and safe performance of the Work.

5.4.11 **TRENCH CROSSINGS:** Contractor shall provide trench crossings wherever necessary to permit the public, property owners or tenants to move across excavated trenches traversing public streets or private property.

5.4.11.1 Contractor shall not remove any trench crossings which permit the public, property owners or tenants to move across excavated trenches traversing public streets or property. Convenient and readily accessible parking and entry to commercial establishments must be maintained.

5.5 USE OF HELICOPTERS

5.5.1 **HELICOPTERS:** PG&E expects the Contractor to utilize helicopters during the performance of the Work. If Bidder intends not to use helicopter, Bidder shall notify PG&E of its intent not to use helicopters prior to or upon submission of Contractor's Proposal for each job.

5.5.2 **REQUIREMENTS:** Helicopter or other aircraft is used by Contractor to perform the Work contained in the Specification of the CWA shall meet requirements set forth below.

5.5.3 **REGULATIONS, PERMITS AND SAFETY**

5.5.3.1 Contractor shall, without cost to PG&E, comply with all federal, state and local laws and regulations and shall obtain and keep in current effect all necessary licenses, fees and permits required for the conduct of its business and the performance of the Work. Contractor's aircraft, or aircraft owned by others and operated by Contractor, shall be operated in accordance with all applicable laws, rules and regulations, including without limitation those of the Federal Aviation Administration and the California State Commission of Aeronautics. Contractor and Contractor's operator shall have full and complete authority over the actual operation of the aircraft and no flight or landing shall be made, or made in any particular manner, unless in each instance Contractor's operator or other representative in charge is, in that person's sole judgment, satisfied with the safety of the proposed flight or landing.

5.5.4 **INSURANCE:** Contractor shall meet the aircraft liability and hull insurance requirements set forth in Sections A.24.6 and A.24.7 of these Specific Conditions.

5.5.5 **LANDING ZONES:** Contractor shall arrange for all necessary laydown space and helicopter landing zones. Contractor will supply PG&E inspector with all contact information, property owners name, and contact numbers prior to any land use for landing zones and work plan for any dust mitigation prior to any scheduled work.

5.6 **REQUIREMENTS FOR MOVING CONDUCTORS**

5.6.1 **ACCORDANCE TO REQUIREMENTS:** Contractor shall perform its Work to move and raise conductor, fiber optic cable and ground wire in accordance with the requirements of all federal, state and local rules and regulations and with the CWA and this Contract including, but not limited to, the items listed in this Section.

5.6.2 **CONDITIONS:** Contractor shall satisfy itself concerning the nature and general location of the Work, the general and local conditions, particularly those affecting transportation, disposal, handling and storage facilities, availability of labor, water, power, roads, climatic conditions, physical conditions at the project area as a whole, topography and ground conditions, equipment and facilities needed preliminary to and during Work prosecution and all other matters which can in any way affect the Work or cost thereof. Contractor's failure to acquaint itself with all available information regarding any applicable or potential Job condition will not relieve Contractor of the responsibility for properly estimating the difficulties and/or cost of successfully performing the Work.

5.6.3 **PG&E RIGHT:** PG&E has the right to stop the Work at any time for safety violations or if Contractor's workmanship does not meet the requirements set forth by this Contract and accompanying documents. Contractor shall immediately correct all deficiencies and will be held responsible for the consequences due to the delay caused by this type of Work stoppage.

5.6.4 **DRAWINGS AND STANDARDS:** Contractor shall familiarize itself fully with the drawings and standards contained herein. Contractor shall also consult with PG&E and manufacturers in order to obtain the recommended methods of installation. Any conflict between the Contractor, manufacturer's installation instructions and PG&E's prescribed procedures for installation shall be resolved by the PG&E Inspector.

5.7 RIGHT-OF-WAY

5.7.1 Contractor may request copies of right-of-way maps which show ownership of lands involved in and along the right-of-way from the PG&E Inspector. Contractor shall check with the PG&E Inspector to determine how much advance notice is necessary for map requests.

5.8 CONSTRUCTION ACCESS

5.8.1 Contractor may not have unlimited access to the Work areas. Contractor shall limit its access to the route shown on PG&E provided maps or as directed by State or Federal permits. Any alternate routes are to be provided by Contractor at its expense and must comply with permit conditions and rights-of-way conditions.

5.8.2 PG&E assumes no responsibility for the condition or maintenance of any existing road or structure thereon that may be used by Contractor in performing the Work under the CWA and this Contract or in traveling to and from the site of the Work.

5.8.3 Existing state highways and county roads are used by the general public. The Contractor shall provide, erect and maintain all necessary barricades, crossing structures suitable and sufficient warning lights, danger signals and signs and shall take all necessary precautions for the protection of the Work and the safety of the public. Roads closed to traffic shall be protected by effective barricades on which shall be placed proper warning and detour signs.

5.8.4 Drainage ditches and all other ditches intersecting the right-of-way and roads thereon may be temporarily altered by bridging or the installation of temporary culverts. All necessary measures shall be taken to maintain the intended function of such ditches throughout the construction period. At the close of the Work, Contractor shall completely restore all altered ditches to their original intended function and capacity.

5.8.5 Contractor shall maintain and repair all roads it uses or damages during the Work. Maintenance of roads shall include, but not be limited to: watering, blading, patching, cleaning of culverts, cleaning of side ditches, removal of fallen snags and trees, removal of rocks and slides, filling washed areas, filling or surfacing soft or slick areas and all other measures necessary to repair damage caused by Contractor's activities.

5.9 INSULATORS

5.9.1 All of the provisions of Article E.23 (Insulators and Hardware) of these Specific Conditions apply to all new insulators and insulators being re-used on all Work covered by this Contract unless specified differently in a CWA.

5.10 EXISTING ENERGIZED POWER LINES

5.10.1 Contractor's attention is specifically called to the fact that some Work will be conducted in the vicinity of existing energized power lines. Sometimes the Work may involve raising the conductors over existing power lines. Contractor shall observe all pertinent Safety Regulations, including the requirements of Title 24, State Building Standards Part 3, latest revision of the California Administration Code. Contractor shall submit a plan to the PG&E Inspector at the pre-construction meeting stating the methods to be used in working near energized lines, especially the methods regarding grounding of de-energized lines in proximity to energized lines.

5.10.2 NON-PG&E UTILITIES: Contractor is responsible for all activities and safety clearances necessary for de-energizing, crossing or grounding of non-PG&E owned electric facilities. Contractor is also responsible for notifying the owners of all non-PG&E facilities that might interfere with or contact Contractor's general Work area. Contractor shall assume full responsibility for all complaints or claims arising from such clearances or contacts.

5.10.3 Contractor is responsible for the protection of all underground facilities in the Work area.

5.10.4 Contractor shall secure conductors adjacent to energized crossings with a safety device capable of upholding conductor weight in event of cable or tool failure.

5.11 CLEARANCES (PLANNED ELECTRICAL OUTAGES)

5.11.1 The PG&E Inspector will obtain, regulate and terminate all clearances and non-tests on PG&E's facilities, as requested by the Contractor. Request for a scope of proposed clearance must be made by Contractor's foreman, in writing, to the PG&E Inspector and at a minimum, the notice shall include:

5.11.1.1 Nature of the Work to be performed.

5.11.1.2 Date and time Work will begin.

5.11.1.3 Date and time Work will be completed.

5.11.1.4 Apparatus to be cleared and the clearance points required.

5.11.1.5 Name and telephone number of the person in charge of the Work.

5.11.1.6 Whether or not protective grounds will be installed.

5.11.1.7 The location of the scheduled work, giving as precise a geographical location as possible.

5.11.1.8 Sketches or details of the proposed work which may be hand-drawn or created electronically by using a graphics program.

5.11.2 Following is a summary of minimum timelines for submitting transmission AFW (Application For Work) forms:

- a. 15 months for critical facilities.
- b. Equipment outages significant to CRRs (Congestive Revenue Rights) and Significant Facilities, and lasting 24 hours or more, submitted on or before the 10th of the month, must be submitted 2 months before the calendar month.
- c. 5 weeks (35 calendar days) for an AFW form requiring engineering review or test programs.
- d. 10 working days for hot washing, hot line work, and total under frequency (UF) relay.

5.11.3 Actual clearance dates and times are at the discretion of the PG&E Switching Center having jurisdiction over the PG&E electric system operation in that area and are subject to rejection, postponement or cancellation at any time by PG&E. Clearances affecting commercial or industrial customers will normally be taken on Saturday or Sunday or outside normal business hours. Contractor shall make every reasonable effort to keep the number and duration of planned outages to a minimum, where such Work can be performed with the lines energized without compromising safety.

5.11.3.1 Contractor needs to plan its work effectively and efficiently. Contractor will not be given an unlimited number of clearances. The actual number of available clearances will be at the discretion of the PG&E Inspector in addition to the Switching Center. Contractor may not be able to obtain clearances every day.

5.11.4 NOTIFICATION TO PG&E: Contractor shall work with the PG&E Inspector and Project

Manager to prepare and submit a completed PG&E Application for Clearance, Load Transfer, Non-test or Notification, Form 62-3470 prior to the requested clearance time. Contractor shall notify PG&E Inspector at least 1 business day prior to performing hot work (work on energized facilities) which will not otherwise involve switching nor require a clearance or non-test. If hot work was not included in Contractor's work plan then additional notification time may be required.

5.11.5 Tools, test equipment and grounds intended to be used in conjunction with a clearance shall be made available for inspection and approval by the PG&E Inspector prior to the clearance date. At a minimum, Contractor shall consult with the PG&E Inspector to confirm that its personal protective grounds are adequate for the maximum fault current of the specific circuits to be grounded. Personal protective grounds rated for 30,000 amp fault current are needed for the circuits in this Work.

5.11.6 Contractor shall perform Work to de-energize or energize electric facilities only in the proximity of the Work area and only to the extent approved by the PG&E Inspector. Contractor shall not, in any event, take any action intended to de-energize, energize, open, close, separate, place in standoff, ground or test any portion of PG&E's electric facilities without explicit authorization from the PG&E Inspector.

5.11.7 Contractor is responsible for cable phasing, voltage checks and motor rotation checks as specified by the PG&E switching tag or as required by the PG&E Inspector. Work shall be verified by the PG&E Inspector.

5.11.8 PG&E expends considerable time and expense in preparing its equipment for the issuance of a clearance. This expense includes overtime for the troubleman to electrically clear the equipment to be de-energized prior to the issuance of an early morning clearance. PG&E will bill Contractor for all time expended and equipment used by PG&E employees in connection with clearances obtained but not utilized by the Contractor. Such amount may, at PG&E's discretion, be deducted from the amount due the Contractor.

5.11.9 At all times between Monday and Friday, Contractor shall maintain the electrical facilities in the Work area in such a manner that the facilities could be placed back into service as soon as possible after notification by the PG&E Inspector, should operating requirements demand. Upon notification by the PG&E Inspector, Contractor shall immediately commence Work necessary to return the facilities to operational status and shall conclude this Work as soon as possible. Contractor's unscheduled Work, such as direction to return the facilities to operation, shall be defined as Additional Work and shall be compensated in accordance with Section 8.6 of the Construction General Conditions.

5.11.10 Under emergency situations, PG&E maintains the right to assist or supplement Contractor's personnel to place the facilities in service as expeditiously as possible.

5.11.11 Line clearances during the day may not be available on some circuits particularly during the May through October time period. Line clearances are typically available during the night from May through October between the hours of 1:00 AM and 9:30 AM. Safe Work methods reducing the need for line clearances are highly encouraged.

5.11.12 Electrical clearances for outdoor construction shall be in accordance with the recommendations in ANSI Standard C37.32, and in accordance with PG&E Electrical Design Standard drawing # 067908, (Document 53 from Table 1).

5.12 GROUNDING

5.12.1 Contractor is responsible for all necessary grounding to ensure safety or protection of facilities from potential hazards and shall ground in accordance with applicable safety laws and appropriate best electrical utility industry standards.

5.12.1.1 Specifically, Contractor shall ground in compliance with Title 8, Division 1, Chapter 4, Subchapter 5, Group 2, Article 36, Section 2941, (i) of the California Code of Regulations.

5.12.2 Contractor shall remove all such grounding devices at the end of each work day to prepare the line for service should PG&E's operating needs require it. Prior to notifying the PG&E Inspector that any line or facility is ready to be returned to service, Contractor shall verify that all of its temporary grounding devices have been removed. Failure to remove such grounds can result in property/facility damage and/or bodily injury, unplanned service interruption, reduced future service reliability, customer economic hardship and PG&E revenue loss. Contractor is responsible for all such damage or injury.

5.12.3 These provisions shall not prevent the Contractor from furnishing and installing as many additional grounds as it deems necessary for the protection of its own personnel against static and accidental contacts with energized circuits. When installing grounds on Fiber Optic Cable, Contractor will install grounds on protective armor rod located at hardware support and will secure grounding devices in a manner to eliminate any possible movement of the grounding devices.

5.12.4 If a conductor or apparatus is not grounded, it must be considered as energized and so treated.

5.12.5 The PG&E Inspector has the authority to issue orders concerning the termination of clearances and the removal of grounds wherever conditions so warrant.

5.13 STEEL TOWER REQUIREMENTS

5.13.1 GENERAL: Work to be performed by Contractor under this Contract may involve installation of cage top extensions. This Work shall be done in accordance with the requirements of these Specific Conditions and any CWA. All referenced standards including their date of adoption or revision shall be as follows and will be referred to by their abbreviation:

5.13.1.1.1 ASTM American Society of Testing and Materials
1916 Race Street, Philadelphia, PA 19103

A123-89a Specification for Zinc (Hot Dipped-Galvanized) Coating on
Products Fabricated from Rolled, Pressed and forged Steel
Shapes, Plates, Bars and Strip, revision dated 1989a

A394-93 Standard Specification for Steel Transmission Tower Bolts, Zinc-
Coated and Bare, revision dated 1993

A572-94c Standard Specification for High-Strength Low-Alloy Columbium-
Vanadium Structural Steel, revision dated 1994c

ES PG&E's Engineering Standard

30 Galvanized Latticed Steel Transmission Towers and Substation
Structures, revision 6, dated 1989

5.13.2 CAUTION: Contractor should be aware that if it is necessary to modify or replace a tower arm, Contractor will be required to unload the tower arm prior to commencing modifications to the tower arm. Contractor shall unload the existing tower arm anytime that the entire arm is to be replaced. Contractor shall work closely with the PG&E Inspector when dealing with modifications to an existing lattice steel tower.

5.14 MATERIALS

5.14.1 GENERAL: Contractor will provide any required tower steel, bolts, nuts and washers. Contractor shall furnish steel for tower raises. Contractor shall provide temporary fiber optic supports.

Contractor shall furnish and apply zinc rich paint for repair of damaged galvanizing. Refer to ES 30.

- 5.14.1.1 Structural shapes provided by PG&E shall be made from ASTM A572, Grade 50 steel.
- 5.14.1.2 Bolts furnished by PG&E shall be ASTM A394, Type "0", with a full shank and recessed nuts. Some bolt heads are square and others are hexagonally shaped. (This information is provided so that Contractor will have the correct tools to perform the Work. The shape of the bolt head does not determine its location in the structure.) All nuts have a hexagonal shape.
- 5.14.2 DELIVERY: Upon delivery of Contractor's furnished fabricated steel, the PG&E Inspector and Contractor shall check the steel for damage and the correct quantity. If there is damage to any item of steel or to the galvanize coating, Contractor shall repair the steel and/or galvanizing as directed by the PG&E Inspector in accordance with Paragraph 2.3 below.
- 5.14.3 DEFECTIVE OR DAMAGED STEEL: Contractor is expected to repair any defective or damaged steel. Corrections shall be made in accordance with the following requirements:
 - 5.14.3.1 BENT PIECES: Contractor shall notify PG&E whenever it finds a furnished structural member that cannot be straightened without damage to the metal. PG&E will take the necessary steps to replace the damaged member. Any structural members which are bent by Contractor shall be repaired or replaced at Contractor's sole expense. Members that can be straightened without structural damage, as determined by the PG&E Inspector, may be straightened by re-rolling in a steel fabrication shop. Any piece that requires heating shall be re-galvanized in accordance with ASTM A123. Absolutely no heating of the steel shall be permitted at the Work site to straighten members.
 - 5.14.3.2 DAMAGED GALVANIZING: For any galvanized steel pieces that show damage, Contractor shall repair the damage before the steel is incorporated into the structure, as noted below:
 - 5.14.3.3 Repair areas smaller than one square inch by cleaning with a wire brush and painting. Paint shall be PG&E Code No. 56, a zinc rich primer or approved equivalent by a PG&E engineer. The paint shall be applied in as many coats as needed to obtain a minimum dry film thickness of 3 mils.
 - 5.14.3.4 Larger areas shall be either re-galvanized or painted, as approved by the PG&E Inspector.
 - 5.14.3.5 If it is necessary to plug-weld misaligned holes, the area shall be painted as specified for small areas if approved by the PG&E Inspector or the entire piece shall be acid-stripped and the base metal properly prepared and re-galvanized in accordance with ASTM A123.
- 5.14.4 BOLT HOLES
 - 5.14.4.1 Reaming of bolt holes shall be performed by Contractor only with the approval of the PG&E Inspector. Reaming may be permitted for correcting undersized holes, removing excess galvanization and for correcting misaligned holes. No hole shall be reamed more than 1/8" greater than its original diameter.
 - 5.14.4.2 Contractor shall drill or punch out any missing bolt holes.

5.14.4.3 Contractor shall repair any galvanized coating damaged while correcting holes by painting as specified in Section B.32 for small areas.

5.14.4.4 Plug-welding and re-drilling or re-punching of a misaligned hole may be performed by Contractor only if approved by the PG&E Inspector.

5.14.5 FIELD CLIPPING

5.14.5.1 Field clipping, also known as coping, shall be performed by Contractor if the clip was missed during fabrication but called for on the fabrication or shop detail drawings.

5.14.5.2 Flame cutting shall not be performed unless authorized by the PG&E Inspector.

5.14.5.3 Contractor shall repair any galvanized coating damaged from field clipping in accordance with the terms of Section B.32.

5.14.6 EQUIPMENT AND METHODS

5.14.6.1 GENERAL

a) Equipment and methods used by Contractor to handle, transport, assemble and erect the steel are subject to the approval of the PG&E Inspector.

b) Contractor shall handle the steel with care to prevent distorting the material or damaging the galvanized coating.

5.14.6.2 EQUIPMENT

a) It shall be Contractor's responsibility to maintain its equipment in a safe and efficient operating condition to keep equipment breakdowns and hazards to a minimum. If any of Contractor's equipment is determined by PG&E to be unfit, it shall be removed from the Work site.

b) Contractor, without additional cost to PG&E, shall have available within 24 hours any equipment required to substitute for non-operative or unsafe equipment. Contractor shall notify the PG&E Inspector if any equipment cannot be replaced within 24 hours.

5.14.6.3 FILLS: One or more fills or washers may be required to equal the thickness shown on the drawings.

5.14.7 WRENCHES

5.14.7.1 Wrenches that damage bolts, nuts or steel are prohibited.

5.14.7.2 Power wrenches and their associated equipment shall be properly maintained and adjusted by Contractor to consistently apply torque within the specified ranges. Calibration shall be checked daily by Contractor in the presence of the PG&E Inspector. Power wrenches that do not maintain the proper torque shall not be used.

5.14.8 ASSEMBLY

5.14.8.1 BLOCKING: Sufficient blocking or construction aids shall be used by Contractor to prevent damage to the steel during assembly.

5.14.8.2 TOWER LEGS: If an entire tower needs to be raised up, PG&E will probably perform that work themselves.

5.14.8.3 ELEVATIONS: The drawings may use two different elevation references. The elevations shown on the drawings as the top of the concrete foundations normally reflect the true elevations as referenced from sea level. The other potential elevation use is internal to the structure itself. These elevations reflect the height above the base of the longest leg extension on the tower.

5.14.8.4 WIND BRACES: Bracing may be added to the structure in order to reduce the vibrations caused by wind on the long, unsupported braces on the outside of the tower. The appropriate drawings show the desired locations of the wind braces. The final locations of the wind braces installed by the Contractor may vary slightly from locations shown in the drawings in order to fit the existing members. The wind braces are to be located so that the holes in the braces fit the cross braces without any additional reaming of the holes. Substantial deviations from the stated locations require the approval of PG&E.

5.14.9 ERECTION OR INSTALLATION

5.14.10 GENERAL: Contractor shall make the modifications to the structure utilizing an appropriate method which results in the proper alignment of the finished product as well as in a sequence best adapted to the equipment and conditions which will not over stress the structural members or their foundations. Subassemblies or total assembly shall be performed by Contractor with the members supported in their proper relative position. Each Bidder shall submit its preliminary plans for the tower modifications to PG&E as part of its Proposal. This preliminary plan shall indicate the method Contractor plans to utilize to lift the pieces or subassemblies into place, such as the use of a helicopter, tower crane, mobile crane, gin pole, etc. The final scheme selected for erection by Contractor shall be submitted in writing to the PG&E Inspector for approval no later than 2 weeks after the award of the Contract.

5.14.11 LIFTING: Contractor shall avoid distorting or over-stressing members during installation. Contractor shall use a bridle and spreader when necessary, protect the tower steel from damage by chokers and use tag lines to prevent the steel from dragging on the ground or against previously erected steel.

5.14.12 BOLTING: Contractor shall install the bolts and nuts in accordance with the requirements below:

5.14.12.1 Bolt lengths and full shank bolt requirements are contained in ES 30.

5.14.12.2 At least 50% of the bolts must be inserted and tightened to the torque specified in Paragraph E.13.3.5 below in each connection before attaching any additional steel to the previous assembly.

5.14.12.3 Insert all bolts in an assembly or in the face of a section before fully tightening any bolt in that portion of the structure.

5.14.12.4 When joining assemblies, bolts may be left loose to allow joining and to obtain the proper alignment of joints and assemblies.

5.14.12.5 Nuts shall be tightened to the following torque:

<u>Bolt Diameter in Inches</u>	<u>Torque in Foot-Pounds</u>
5/8	70 to 100
3/4	125 to 150

5.14.13 PG&E's Inspector may randomly check a minimum of 25% of the bolts in each assembly. Torque will be checked in a tightening motion with a calibrated hand torque wrench. If 10% or more of the bolts checked are outside the specified range within each assembly, Contractor shall loosen

and re-tighten every bolt in that assembly at no additional cost to PG&E. Bolts damaged by over-torquing shall be replaced at Contractor's expense.

- 5.14.14 Bolts shall be double center punched in two places, at a 45° angle to the threads after tightening in such a manner that penetrates both the threads and the nut (inside 90° angle at the top of the nut).

- 5.14.15 ALL NUTS SHALL BE INSTALLED FACING OUTWARD AND/OR UPWARD FROM THE STRUCTURE OR FRAME. THIS WILL ALLOW ALL NUTS TO BE VIEWED FROM THE OUTSIDE OR FROM THE TOP OF THE STRUCTURE.

5.15 TOWER COMPLETION:

- 5.15.1 All construction and clean-up work shall be completed by Contractor within two weeks following the tower's modification. Contractor is responsible for inspecting and correcting its Work at no additional cost to PG&E. Tower modification completion shall include, but is not limited to, the following actions:

- 5.15.2 Installation of any missing bolts and steel members by Contractor.

- 5.15.3 Nuts tightened to the specified torque.

- 5.15.4 Repair of any damaged coating in accordance with Section B.32 of these Specific Conditions.

- 5.15.5 Correction of any deficiencies identified during the final inspection in accordance with Section 4, Paragraph 5.6 of this Module.

- 5.15.6 DAMAGED STEEL: Steel damaged during erection shall be repaired by Contractor at its sole expense in accordance with Section 4, Paragraph 2.3 above of this Module.

- 5.15.7 FINAL INSPECTION: Contractor shall notify PG&E when it is ready for the final inspection by PG&E. Final inspection of the tower will be made by the PG&E Inspector to ascertain that the tower is erected in accordance with this Specification and the drawings incorporated therein and will permit the installation of the electrical conductors by Contractor. PG&E will notify the Contractor of any deficiencies found during the final inspection. Any noted deficiencies shall be corrected by Contractor in a timely manner at its sole expense.

5.16 INSTALLATION OF CONDUCTORS

- 5.16.1 All conductor Work shall be performed in accordance with the applicable requirements of all federal, state and local rules and regulations and with this Specification.

- 5.16.2 The Contractor shall submit with his proposal a brief description of the methods and equipment to be used for wire stringing.

- 5.16.3 All of the related provisions of these Specific Conditions also apply to this portion of the Work. They will not be repeated in their entirety in this Section.

- 5.16.4 EQUIPMENT AND TOOLS: Contractor shall furnish the necessary equipment and tools to perform the Work required under a CWA and this Contract. This includes, but is not limited to, all of the necessary hoists, grips, splicing tools, travelers, reel dollies, conductor pulling equipment, etc. Contractor shall utilize appropriately sized tools and equipment for the conductor being installed.

- 5.16.5 STRUCTURE LOADING: Stringing and sagging operations shall be conducted so that no structure will be subjected to unbalanced longitudinal or torsional loads in excess of

the safe working loads. Contractor shall perform their Work so that there is no undue stressing of the poles and towers. Contractor shall take care in their rigging methods in order to prevent damage to the structures, including, but not limited to, the buckling of the tower arms.

5.17 PREPARATORY WORK

5.17.1 Prior to commencing the changing of conductor Work along an existing transmission line, Contractor shall perform the other assigned Work such as, but not limited to, installation of new wood or steel poles and the transferring of equipment from the old poles to the new poles. Details pertaining to these aspects of the assigned Work are contained in the other Sections of these Specific Conditions.

5.17.2 The portions of these Specific Conditions pertaining to Grounding also apply to the Work involving the replacement of the conductors.

5.18 CLEARANCES

5.18.1 The provisions of Article E.8. and it's Sub Articles of this Module (Clearances) also apply for the reconductoring portion of the Work.

5.18.2 All reconductoring Work on transmission lines is to be performed under a Clearance issued to de-energize the conductors being worked upon. In some cases, handling of distribution circuits may have to be performed under energized conditions.

5.18.3 Some clearances may not be available during regular week day hours. They may be available only on Saturday or Sunday or at night. If known at the time of bid solicitation, information concerning non-regular work hours clearances will be included in the specific CWA issued for a given block of Work.

5.18.4 Contractor should be aware that requests for clearances on circuits, other than the circuit being reconductored, may not be granted by PG&E. In addition, such clearances, when granted, may occur outside of Contractor's normal work hours. Regardless of the outcome of such a clearance request, Contractor shall perform the Work at no additional expense to PG&E.

5.19 STEEL POLES OR LATTICE STEEL TOWERS

5.19.1 Reconductoring Work will involve existing steel poles or lattice steel towers. In general these support structures will not need to be replaced prior to replacing the conductors. However, the conductor replacement Work may require the existing anchors or guy wires to be changed if specified in the CWA Job Instructions.

5.19.2 Anything unique to the existing steel poles or lattice steel towers will be covered in the CWA Job Instructions.

5.20 HANDLING REELS

5.20.1 Contractor shall inspect each reel upon receipt from the Company to determine whether or not damage has occurred during transit or storage and shall immediately report any evidence of damage to the PG&E Inspector. The Contractor shall not accept or move damaged reels until a thorough inspection has been made to determine the extent of the damage.

5.20.2 Contractor shall handle the reels in such a manner as to prevent smashing, nicking, cutting or otherwise damaging the conductor. When unloading reels, they shall not be dropped to the ground or allowed to roll freely down ramps. Cranes or other equipment of adequate capacity shall be used and care shall be taken to avoid damage to the conductor or reels.

- 5.20.3 Identification tags and markers shall be retained on the reels. The Contractor shall record on forms supplied by the PG&E Inspector and for future reference, the reel number, length of wire and the approximate tower numbers in the line where the conductor from each reel was installed.
- 5.20.4 Lagging or other protective covering shall be removed at the job site and the outside layer of each reel shall be examined by the Contractor to ensure that the conductor is in good condition and undamaged and that no nails, staples or other sharp objects which could damage the conductor during unreeling protrude on the inside of the reel heads. If damage is found upon removal of the protective covering, the Contractor shall notify the PG&E Inspector before using the reel.
- 5.20.5 Contractor shall return all empty returnable reels to PG&E. These reels are part of the salvage material with a value discussed in Section 2, Paragraph 4 of this Module. Contractor shall dispose of all empty non-returnable reels (primarily constructed of wood) unless otherwise instructed by PG&E.

5.21 CONDUCTOR INSTALLATION

- 5.21.1 The stringing operation shall be performed only on structures which have been accepted by the PG&E Inspector.
- 5.21.2 In no case shall conductor to be installed on structures, either towers or poles, with concrete foundations before the tower foundation concrete has cured for at least 28 days and the test cylinders have met the strength requirements.
- 5.21.3 At least two weeks prior to Contractor's anticipated start of installing the new conductor, Contractor shall submit to the PG&E Inspector, for review and approval, a detailed plan to install, tension, sag and clip in the new conductor. This plan shall include all anticipated conductor stringing set-up locations. Contractor shall be reasonable in their request and plans, particularly in hilly or mountainous terrain. Schedules shall be provided at least two weeks in advance and shall include the following information:
- 5.21.3.1 Location of reels to be pulled and line section of each.
 - 5.21.3.2 Serial number of conductor reels.
 - 5.21.3.3 Location of tensioner.
 - 5.21.3.4 Location of puller.
 - 5.21.3.5 Anchor location for securing conductor upon completion of sags.
 - 5.21.3.6 Sag spans to be used (by structure numbers).
 - 5.21.3.7 Location of splices to be installed.
 - 5.21.3.8 Failure to comply with this request could delay the stringing of conductors, of which no additional cost will be borne by PG&E.
- 5.21.4 Locations of Contractor's pulling and tensioning equipment, temporary construction anchors and permanent splices shall be identified by the line station number.
- 5.21.5 It is very important to avoid damaging the conductor or the associated fittings in any way and it shall be the Contractor's responsibility to protect the cable and other materials furnished by PG&E against damage.
- 5.21.6 Contractor shall utilize the tension stringing method when installing the conductor. The pay-out

tension in this method shall be limited at all times to less than 60% of the final sagging tension.

5.21.7 During the conduct of Work, Contractor will have to remove the existing conductor. The old, existing conductor is to be consolidated by the Contractor at a PG&E designated location for PG&E's recovery.

5.21.8 Contractor is to provide all of the necessary tools and equipment to install the new conductor including "clipping in" (attachment of the conductor to the insulators) and to collect the old conductor (refer to Section 2, Paragraphs 4.3 and 4.4 of this Module).

5.22 SHEAVES

5.22.1 All sheaves used during the installation of the conductor shall have an approved neoprene lining.

5.22.2 Sheaves shall be appropriately sized for the size and type of conductor being installed. Sheave diameter and groove radius shall be in accordance with the requirements contained in the IEEE Guideline 524-1992, IEEE Guide to the Installation of Overhead Transmission Line Conductors.

5.22.3 Contractor shall take particular care to insure that all sheaves are free rolling and are free of defects.

5.22.4 Prior to the start of the pulling operation, Contractor shall have the PG&E Inspector review the rigging and methods to be used by the Contractor. The responsibility to correctly perform this Work remains with the Contractor even after PG&E's inspection.

5.22.5 The new conductor is not to touch the ground. Contractor's work methods shall be such that the conductor is removed from its shipping reels and placed into the air. All conductors shall be kept under sufficient tension during stringing to prevent contact with the ground, fences, guard poles, wires or structures.

5.22.6 The equipment and methods used for unloading, handling and stringing conductors shall be such that the cables and associated materials shall not be damaged and shall be subject to the approval of the PG&E Inspector. Particular care shall be taken at all times to ensure that the cables do not become kinked, twisted, flattened or abraded in any manner.

5.22.7 If conductors or associated materials are damaged due to the Contractor's negligence or faulty equipment, the Contractor shall replace the damaged sections, including the furnishing of the necessary materials, in a manner satisfactory to the PG&E Inspector and at no additional cost to PG&E. All sections of cable that are damaged by the application of grips shall be replaced.

5.23 SPLICES AND DEADENDS

5.23.1 The new conductor is usually installed from one deadend structure to another deadend. The number of splices shall be kept to a minimum consistent with the economical use of the conductor.

5.23.2 All splices on the new transmission conductor shall be a minimum of 25 feet from suspension or post insulator clamps and 100 feet from deadend clamps.

5.23.3 Any splices on distribution circuits shall be a minimum of 4 feet from the point of attachment (at the insulator) to the splice.

5.23.4 Splices shall not be made in the crossing span over a railroad, river, canal, telephone lines, telegraph wires, transmission lines above 60 kV and federal and state highways. Where practical, splices shall not be installed in spans adjoining spans crossing over a railroad, river, canal, telephone lines, telegraph wires, transmission lines above 60 kV and federal and state

highways. Splices shall not be made in the span entering a substation.

- 5.23.5 Contractor shall furnish all necessary tools, including compressors, required for applying compression joints or splices, repair sleeves and compression type deadend fittings.
- 5.23.6 Unless otherwise specified in the drawings or directed by the PG&E Inspector, splices and deadends shall be applied to the conductor in accordance with the recommendations of the manufacturer. Approved clamps shall be used at each cutting point to prevent unraveling.
- 5.23.7 Splices shall not be pulled through stringing blocks.
- 5.23.8 Straightening of splices in excess of 1" arc measured at the center of the sleeve is not permitted and shall be rejected. Any splice distorted during compression by more than 1" measured at the center of the sleeve shall be rejected and replaced by a new splice at no additional charge to PG&E.

5.24 JUMPERS

- 5.24.1 Jumper loops shall be of proper length and formed so that electrical clearances are maintained to all structural members as shown on the drawings.
- 5.24.2 Uplift on jumper insulator assemblies will not be permitted.

5.25 SAGGING CONDUCTORS

- 5.25.1 Conductors are to be sagged in accordance with the initial sag tables furnished to the Contractor by PG&E in the appropriate Specification to the CWA for each specific block of Work. The conductors shall be sagged to the ruling span sags and tensions corresponding to the temperature at the time of stringing as shown by the proper stringing table. The temperature shall be determined from a sagging thermometer that is inserted into a piece of conductor which is approximately 30" long. The sagging thermometer shall be installed sufficiently prior to the actual sagging operation to allow temperature stabilization and shall be mounted above ground, in the same direction as the conductor and not in the shade. The temperature measurement obtained from the sagging thermometer shall be used for making temperature corrections to the sag tables.
- 5.25.2 Contractor should be aware that there may be occasions when PG&E wants to be involved in the final sagging of a particular conductor. In those cases, the PG&E Inspector, with input from the Contractor, will schedule the appropriate PG&E engineering personnel to assist in the sagging operation. The final determination of the correct sag will be made by PG&E when this field assistance is provided.
- 5.25.3 In some situations, the same structure (pole or tower) will support both transmission and distribution circuits. These circuits must be kept apart from one another. The separation distance between the circuits would be specified in the CWA Job Instructions for each specific block of Work which includes this type of condition.
- 5.25.4 The length of conductor sagged in one operation shall be as limited to the length that can be sagged satisfactorily considering the terrain, the number of angles in the line and the length of conductor which can be uniformly sagged, but in no case exceeding 4 miles in length.
- 5.25.5 At the time of sagging conductor, the sag of any given phase shall be within a tolerance of plus or minus 1/2" sag of the theoretical value for each 100 feet of span length, but not more than 6" in any one span. The sub-conductors for each phase shall be sagged with a tolerance within 2" of each other.

- 5.25.6 E.23.6. The sag shall be checked by the Sighting Method in at least one span in each sag section less than five spans, in two spans in each sag section of five spans to eight spans and in three spans in each sag section of nine or more spans.
- 5.25.7 SIGHTING METHOD: There are three types of sighting sagging methods used: Calculated Angle of Sight Method, Calculated Target Method and Horizontal Line of Sight Method. The Sighting Method may be used with structures whose conductor supports are on different elevations, as well as for those whose conductor supports are on the same elevation. The length of span used for checking should be that closest in length to the ruling span. Where only one span is used for checking the sag, it shall be in the approximate middle of the sag section. Where two or more spans are used for checking the sag, these spans shall be located approximately equidistant from each other and from each end of the sag section.
- 5.25.8 The use of a dynamometer as the final check on the conductor sags is not allowed. A dynamometer may be used only to check results obtained by the Sighting Method or for the purpose of obtaining additional data. The dynamometer shall be accurately calibrated and sized so that the anticipated readings will be approximately mid-scale. The location of the measuring device on the conductor is critical to the accuracy of the readings due to the efficiency loss from the sheaves.
- 5.25.9 The Stopwatch Method or Return Wave Method of determining sag may be used only to check results obtained by the Sighting Method.
- 5.25.10 The PG&E Inspector or Engineer shall check the sag at any point deemed necessary and the Contractor shall furnish the necessary personnel for signaling and climbing purposes. When the PG&E Inspector or Engineer checks the sag, it shall be done as soon as practical after the Contractor has completed its sagging and has indicated that the sag is correct.
- 5.25.11 E.23.11. On sag sections in hilly terrain, in may be necessary to use sag corrections and clipping offsets. Clipping offsets will be provided to the Contractor by the PG&E Inspector after approval of the snub locations selected by the Contractor. In line sections where clipping offsets are specified, all conductors shall be marked at a point vertically below the insulator attachment point. All marking of a sag section shall be completed immediately after the completion of the sagging operation. After clipping in, all suspension insulator strings shall hang plumb.
- 5.25.12 Sagging operations shall not be carried on when, in the opinion of the PG&E Inspector, wind, low temperatures or other adverse conditions prevent satisfactory sagging.
- 5.25.13 Mark position of conductor on clamp, move conductor to next higher insulator, sag conductor to make adjacent insulators hang plumb.
- 5.26 INSULATORS AND HARDWARE
- 5.26.1 All new insulators for Work on transmission circuits will be furnished by PG&E. Post insulators shall be either non-ceramic or ceramic type. Suspension and strain insulators shall be non-ceramic, ceramic or glass type.
- 5.26.2 Contractor shall inspect the insulators at the time of receipt from PG&E. Contractor shall replace or pay for all insulators which are damaged after receipt from PG&E.
- 5.26.3 Contractor shall inspect the insulators prior to being installed. Contractor shall notify the PG&E Inspector concerning any damage to the new insulators. Contractor shall install only undamaged insulators.
- 5.26.4 No chipped or broken insulators shall be used. All insulators shall be carefully handled while being transported, assembled and installed. Insulators shall be kept in their shipping package as

long as possible and thoroughly wiped with clean rags to remove grass, twigs, dirt and other foreign matter immediately prior to installation. Wire brushes shall not be used for cleaning any of the parts. Insulator surfaces of ceramic and glass insulators shall be wiped to a bright finish. Metal surfaces shall be free from noticeable contamination. At no time shall workmen be allowed to climb on insulators or conductors.

- 5.26.5 Insulators shall be protected from the ground during hanging operations. Ceramic and glass insulators shall be handled with care to prevent chipping or cracking the insulation and to avoid excessive bending strain on the pin shanks or caps.
- 5.26.6 Non-ceramic insulators shall be handled with care to prevent tearing, ripping or other damage to the sheds and sheaths and to avoid excessive bending strain on the rods or end fittings.
- 5.26.7 A cradle or similar approved device shall be used to lift insulator strings. Insulators that are damaged in any way shall be disposed of by Contractor after the PG&E Inspector has confirmed their damage. Damaged insulators shall not be left along the right-of-way.
- 5.26.8 Insulator strings and cotter pins shall be assembled and installed as shown on the drawings. The head of all cotter keys shall be checked to ensure proper seating. In all cases, hardware shall be installed so that the cotter keys and bolts can be removed with the use of hot sticks. All pins in suspension units and hardware shall be turned so that the head of the cotter key is turned toward the structure or upward. On angle-in-line structures and deadend structures, the cotter key head shall be up. Horizontal post insulators, if required, shall be installed as shown on the drawings.
- 5.26.9 Insulators of the strength and class shown in the drawings with the associated hardware shall be used. Extreme care must be used to ensure insulator sizes are not mixed.
- 5.26.10 Hold-down weights shall be added to insulator strings where indicated on the drawings.
- 5.26.11 Dampers shall be installed where indicated on the drawings. Dampers shall be installed with bolt heads turned toward the structure. After attachment and tightening of bolts, the damper shall hang vertically below the conductor unless otherwise specified.
- 5.26.12 Bundle conductor spacers shall be installed where indicated on the drawings. The Contractor shall take special care when installing bundle conductor spacers, paying particular attention to the manufacturers torque values and pertinent specifications.
- 5.26.13 Clamp bolts and all other hardware bolts shall be torqued in accordance with manufacturer's specifications.
- 5.26.14 Packing crates and all other materials used for the protection of insulators and hardware shall be removed for the Rights-of-Way at the time assemblies are installed on the structures. Should the Contractor fail to comply with this requirement within 48 hours of being given written notice to do so, the PG&E Inspector will take necessary corrective action and the cost shall be borne by the Contractor.
- 5.27 CLIPPING-IN CONDUCTORS
- 5.27.1 Conductors shall be clipped in the same day the sag is made, whenever this is practical. In no case shall conductors be clipped in later than the second calendar day following sagging operations.
- 5.27.2 The total time which conductors are allowed to remain in the stringing blocks before being clipped in shall not be more than 72 hours.

5.28 GUARD STRUCTURES

- 5.28.1 Unless otherwise approved by the PG&E Inspector, Contractor is responsible to protect all crossings, including, but not limited to, street, highway and railroad crossings, canals and other power and communication lines, during the installation of the new conductors.
- 5.28.2 Contractor shall install and remove after their use all guard structures used for the protection of all crossings (see Paragraph 10.1 above) and conductors included in each specific Work assignment. Contractor shall provide all materials required for such guard structures.
- 5.28.3 Contractor's quotation shall include all necessary costs involving any guard structure.
- 5.28.4 Contractor shall design and construct the guard structures so that they have adequate strength to support the conductor. However, Contractor shall not allow the conductor to be dragged across the top of any guard structure during the conductor installation and sagging activities.
- 5.28.5 Due to the lead times necessary to obtain the encroachment permits from the various State of California agencies, PG&E may have to apply for these permits prior to the selection of a Contractor to perform the Work. Therefore, in the permit applications, PG&E will state that the work will follow the guidelines issued by that agency. Contractor shall be familiar with these guidelines from the California Department of Water Resources and the California Department of Transportation. Any costs associated with complying with these guidelines are to be included in Contractor's quotation.

TABLE 1 - REFERENCED PROJECT WORKSCOPE DOCUMENTS AND SPECIFICATIONS

This list below outlines the current documents and Specifications as of the time of writing these Specific Conditions and is included for informational purposes only. Please access the below website to view and access the up-to-date list and latest revision edition. PG&E reserves the right to add, delete or revise applicable documents and Specifications and will update the website for access to reflect the up-to-date changes. These documents and all revisions thereto are available to Contractors with PG&E approved access or provided laptop through the link: \\Fairfield02\etecse\EPC CONTRACTORS DOCUMENTS. PG&E expects Contractor's Proposal and Work Scope to be fully informed and accurate and no change orders will be issued should Contractor's Proposal or Work Scope fail to account for the requirements provided for in the documents listed in Table 1.

Section A.1.6 shall apply to these referenced documents.

Attachment	File Name	Title
1	PG&E Form F3330-02-03	Project Scope Document
1A	Proposal Submittals Compl Chart.pdf	Proposal Submittals Compliance Chart
1B	Proposal Submittals Instructions_Rev7.pdf	Instructions for Preparing Commercial and Technical Proposal Submittals for EPC Projects
1B1	PG&E EPC Proposal Form 1B1	Proposal Submittals Table of Contents
1C	(Contractor to provide file name) if not applicable specify "not used or N/A"	Existing Single Line Diagram
1C1	(Contractor to provide file name) if not applicable specify "not used or N/A"	Proposed Single Line Diagram
1D	(Contractor to provide file name) if not applicable specify "not used or N/A"	Existing General Arrangement
1D1	(Contractor to provide file name) if not applicable specify "not used or N/A"	Proposed General Arrangement
1E	(Contractor to provide file name) if not applicable specify "not used or N/A"	Existing Single Line Meter & Relay Diagram
1E1-1Z	(Contractor to provide file name) if not applicable specify "not used or N/A"	Contractor shall expand and populate specific engineering drawings as required for the project.

Attachment	File Name	Title
2	Substation Fire Protect Process.doc	Process Flow Map for Fire Protection at Substations
3	041838_R23.pdf	General Notes for Grading and Paving for Substation Sh 1 to 4 (Rev 23)
3A	DC 073111.pdf	Design Criteria 073111 General Arrangement (Rev 01)
4	ES Spec 87_R2.pdf	Engg Material Specification No. 87 for All-Aluminum Conductor. (Rev 2)

Attachment	File Name	Title
5	059659_R4.pdf	Property Fences and gates (Rev 4)
5A	TD059659B-001.pdf	Utility Bulletin Substation Security (Perimeter) Fencing (Rev 0)
6	059660_R2.pdf	Fence Elevations and notes Property Fence & Gates (Rev 2)
7	059661_R1.pdf	Gate Elevations and Notes Property Fence & Gates (Rev 1)
8	059662_R1.pdf	Fence Details Property Fence & Gates (Rev1)
9	020607_R21.pdf	Engg Standards -Method of Grounding Fences and Wire Trellises Sh 1 to 7 (Rev 21)
10	ES Spec 30_R7.pdf	Engg Standards-Specification No. 30 for Galvanized Latticed Steel Transmission Structures (Rev 7)
11	ES Spec 81_R10.pdf	Engg Standards-Specification No. 81 for Steel Structures for Substation (Rev 10)
12	ES Spec 3611_R1.pdf ES Spec 3611_R1 Addendum3.pdf ES Spec 14_R4.pdf	Specification No. 3611 For Circuit Breakers, 72.5-242kV, Outdoor Type(Rev 1) with Addendum 3 dated 4/30/2010 Engineering Standard No. 14 Specification for Insulating Gas, Sulfur Hexafluoride (SF6)
12A	ES Spec 2790_R4.pdf	Specification 2790 for Circuit Breakers, 500kV Outdoor Type (Rev 4)
12B	DC 073133.pdf	Design Criteria 073133 Circuit Breakers and Circuit Switchers
12C	SF6 Inventory Form.xls	Record of SF6 Inventory- Construction Contractors Sites

Attachment	File Name	Title
13	ES Spec 6757_R2.pdf	Specification No. 6757 For Disconnecting Switches, 72.5 -245 kV. Group Operated (Rev 2)
13A	333630_R13.pdf	Requirements For 15 & 21kV Hook Stick Operated Switch Low Profile Substation (Rev 13)
13B	ES Spec9149.pdf ES Spec9149_Addendum.pdf	Specification 9149 for Disconnecting Switches 500KV. Addendum to Disconnect Switches 500kV
13C	DC 073136.pdf	Design Criteria 073136 Switches, Disconnect (Rev 00)
14	034851_R19.pdf	Steel Grating Type Switch Operating Platform Sh 1 to 3 (Rev 19)
15	067906_R3.pdf	Post Type Apparatus Insulators Sh 1 to 14. (Rev 3). Sh 15 to 22 (Do Not Purchase)
15A	DC 073138.pdf	Design Criteria 073138 Insulators(Rev 00)
16	OH Transmission 015014_R5.pdf	Suspension Type Insulators (Rev 05)
16A	Engg Mat Spec 66.pdf	Suspension Type Insulators (Rev 3)
17	459983_R10.pdf	Requirements for Voltage Transformers and Coupling Capacitor Voltage Transformers (Rev 10)
17A	DC 073141.pdf	Design Criteria 073141 Instrument Transformers (Rev 00)
18	459984_R10.pdf	Requirements for 115, 230 & 500V Carrier Equipment (Rev 10)
18A	IB0202.pdf	Power Line Carrier-Cable Retrofit, Substation Engineering Bulletin (8/1/2003)

Attachment	File Name	Title
19	058104_R12.pdf	Typical Arrangement of Voltage Transformer, Coupling Capacitor and Coupling Capacitor Voltage Transformer. Sh 1 to Sh 35. (Rev 12)
20	067909_R1.pdf	Ampacity of Outdoor Bus Conductors Sh 1 to 7 (Rev 1)
21	OH Conductors 030559.pdf	Ampacity of Overhead Line Conductors (Rev 0)
22	046267_R14.pdf	Copper and Aluminum Power Connectors Sh 1 to 30 (Rev 14)
22A	064116_R3.pdf	Aluminum Bus Connectors & Fittings for 500KV Stations Sh 1 to 15 (Rev 3)
23	052646_R1.pdf	Requirements for Control of Wind Vibration of Tubular Aluminum Bus Sh1 to 2 (Rev 1).
24	037788_R6.pdf	Application of Aluminum Conductors and Connections for Substation Use Sh 1 to 3 (Rev 6).
24A	068008_R2.pdf	Application of 60KV-230KV Hardware for Aluminum Conductors in Transmission Substation Sh1 to 26 (Rev 2)
24B	436340_R3.pdf	Standard Line Hardware for Aluminum Cable -500KV Stations (Rev 3)
25	054031_R11.pdf	Engg Standards-Warning Signs, Danger Sh 1 to 22 (Rev 11)
26	4024951_R1.pdf	Assembly for Duplex 19" Switchrack for Transmission and Distribution Substation (Rev 1)
27	4024952_R1.pdf	Fabrication Details for Simplex and Duplex 19" Switchrack (Rev 1)

Attachment	File Name	Title
28	ET-High Volt CB.pdf	High Voltage Circuit Breaker A.C. and D.C. Circuits, Electric Transmission Guideline (DRAFT)
29	SSREL.pdf	DC Supply for Solid State Relays, Substation Engineering Memorandum, April 23, 1990.
29A	DC Supplies to Digital Relays Bulletin.pdf	Bulletin-DC Supplies to Digital Relays
29B	DC Requirements-BAAH-Non 500KV relays.pdf	DC Requirements for BAAH non 500kV Relays
29C	Switchrack DC Terminal Block Assignment. pdf	Switchrack DC Power Supply Terminal Block Assignment for IPAC Relays
30	023607_R14.pdf	Control Switch Handles, Indicating Lamps, Mimic Busses, Charting Tape for Maps and Arrangements Sh 1 to 4 (Rev 14)
31	6356.pdf	Specification for Furnishing & Delivering Solid State Annunciators for Electric Substations
31A	DC 073156.pdf	Design Criteria 073156 HMI (Human-Machine Interface) (Rev 00)
31B	06-0004.pdf	Electric Operations Bulletin 06-0004 HMI and SCADA Screen Templates
31 C	DC 073162.pdf	Design Criteria 073162 Communications, SCADA Applications (Rev 00)
32	054552_R5.pdf	Terminals, Butt Splices and Tools for Copper Control Wire, Size No. 22 to No. 2 AWG, Sh 1 to Sh 4.(Rev 5)
32A	070423_R2.pdf	Wire Labels for Pre-Wired Cabinets & Modular Control Buildings Sh 1 to 8 (Rev 2)

Attachment	File Name	Title
33	057384_R4.pdf	Standard and Short Circuit Type Terminal Blocks (Rev 4)
34	445471_R7.pdf	Duplex Type Switchboard Construction Details, (Note: For Reference Only) Rev 7
35	042909_R9.pdf	Nameplates for Use at Substations Sh 1 to 25 (Rev 9)
36	027818_R11.pdf	Nameplates for General Use (Rev 11)
36A	DC 073118_R1.pdf	Design Criteria 073118 Signage(Rev 01)
37	Distrb Reactor Ref Dwgs Folder	Neutral Reactor (MicrostationDwg Format)
38	ES Spec 6679_R3.pdf	Specification for Batteries and Battery Racks (Rev 3)
38A	DC 073116_R1.pdf	Design Criteria 073116 Low Voltage AC and DC System (Rev 01)
39	ES Spec 1546_R3.pdf	Specification No. 1546 for Battery Chargers, Regulated (Rev 3)
40	459076_R11.pdf	High Pressure Sodium Outdoor Lighting (Rev 11)
40A	DC 073117_R1.pdf	Design Criteria 073117 Lighting Systems (Rev 1)
41	334754_R4.pdf	Arrangement of Convenience Outlets for Outdoor Installations (Rev 4)
42	067910_R4.pdf	Grounding Requirements for Outdoor Elect Substations Sh 1 to 15 (Rev 4)
42A	DC 073114.pdf	Design Criteria 073114 Grounding-Electric Substation (Rev 00)

Attachment	File Name	Title
42B	WP3320-11.pdf	Work Procedure WP3320-11 Repairing Damaged or Missing Equipment Ground Leads
42C	Substation GroundingReqForm.docx	ATS Substation Grounding Request Form
43	062288.pdf	Elect U/G Constr Manual-062288 Underground Conduits (Rev 8)
43A	068192.pdf	Elect Transm Line Standards-068102 Underground Transmission Line Design Criteria (Rev 00)
43B	072140.pdf	Elect Transm Line Standards- 072140- Underground Transmission Line Cable System Installation Guide. Dated 1/30/08 (Rev 00)
44	334929_R5.pdf	Civil Design Standards Concrete Pull Box for Outdoor Conduits (Rev 5)
45	335189_R4.pdf	Civil Design Standards Aluminum Covers for Concrete Pull Boxes (Rev 4)
46	039999_R5.pdf	Device Numbers and Functions Sh 1 to 15 (Rev 5)
47	043670_R14.pdf	Graphic Symbols for Electrical Diagrams Sh 1 to 26 (Rev 14)
48	504848_R6.pdf	Design Standards Schedule of Standard Sizes of Drawings &Printed Formats used by the Engineering Department (Rev 6)
49	026300.pdf	OH General Insulation Districts for Overhead Lines and Stations (Rev 1)

Attachment	File Name	Title
50	362371.pdf to 362386.pdf	List of Approved Protective Relays (Revisions 2 & 3 see Dwg)
51	448226_R10.pdf	Electrical Design Standards Typical Cable Tray Assembly Drawing (Rev 10)
52	ES Spec 34_R1.pdf	Engineering Standards Specification 34 for Bus Conductor Aluminum-Alloy Seamless Pipe (Rev 1)
53	067908_R4.pdf	Electrical Design Standards Outdoor Electrical Clearances for Transmission and Distribution Substations Sh 1 to 7 (Rev 4)
53A	470591.tif	Elect Clearances For 60KV, 70KV, 115KV & 230KV Overhead Transmission Lines (Rev 2)
54	G13039.pdf	Utility Operations Guideline G13039 Electrical System Protection Design Philosophy (9/1/2006)
55	DC 073131_R2.pdf	Design Criteria Bus Configuration (Rev 02)
56	DC 073137_R1.pdf	Design Criteria 073137 Bus and Cable (Rev 01)
57	sec 6_3.pdf	Sect 6.3, Control and Switchboard Wire

Attachment	File Name	Title
57A	211520_R1.pdf 330472_R4.pdf 432264_R17.pdf	Transformer Shielding Req for Fault Press Relay, Shielding Req for Cable Between Fault Press Rly & Main Swbd, Fault Press Protection Scheme (For Ref Only)
58	053449_R6.pdf	Test Switches for Current, Potential, and Control Circuits Sh 1 to 10 (Rev 6)
59	WP3330-01.pdf WP3330-1 Attach 1.pdf WP3330-1 Attach 2.pdf WP3330-1 Attach 3.pdf WP3330-1 Attach 4.pdf Process Map Plan Job Walkdown.pdf Process Map Conduct Job Walkdown.pdf	Work Procedure-WP3330-01 Job Walkdown Checklist Forms and Process Maps
59A	WP3330-02.pdf WP3330-02_Attch1_ Sponsor Apprvl of Scope Process Map.pdf WP3330-02_Attach 2_Non Apprvl Resolution Process Map.pdf F3330-02-3.doc	Work Procedure-WP 3330-02 Sponsor Approval of Scope Form F3330-02-3-Project Scope Document & Process Maps
60	Wp_3330-05.pdf Wp_3330-05_Attch A.pdf Wp_3330-06.pdf Wp_3330-06_Attch A-D.pdf Wp_3330-06_Attach E.pdf	Constructability Review & Design Review
60A	WP3330-03.pdf F3330-03-1.doc F3330-03-2.doc F3330-03-3.doc WP3330-04-Attach 4.pdf WP3330-05-Attach 5.pdf	Work Procedure WP3330-03 Scope and Design Change Forms, Process Maps and Examples
61	F1004-1.doc F1004-2.doc F1004-3.xls WP1004-01.pdf	Determination of Electric Transmission Facility Rating (Construction Plan)

Attachment	File Name	Title
62	463739_R6.pdf 463740_R6.pdf 463741_R7.pdf 463742_R5.pdf	Electrical Design Standards Requirements for Outdoor AC Distribution Panelboards
63	463743_R3.pdf 463744_R5.pdf	Electrical Design Standards Requirements for Indoor AC & DC Distribution Panelboards
64	WP-3360-02.pdf, WP_3360-02 Attch1 to 4.pdf DC 073154.pdf	WP-3360-02-Remote Access for Recording Multifunction Meter with 4 Attachments, SCADA Protection & Meter Req for Substation Transformers
64A	4031725_R3.pdf	EDS-SCADA Cabling Diagram (Rev 3)
64B	4052764_R2.pdf	EDS-Typical SCADA Cabling Diagram for 12/17/21kV Switchgear with HMI (Rev 2)
64C	4025180_R3.pdf	EDS-Schematic Diagram of Communication Equipment (Rev 3)
65	330006_R18.pdf	CDS-Steel Support For Carrier Current Line Traps & Coupling Capacitor Tubular Design (Rev 18)
66	DC 073115_R3.pdf	Substation Design Criteria 073115 Memorandum (DCM E-1.5) Fire Protection (Rev 3)
66A	SCADA Fire Alarms.pdf	SCADA Fire Alarms and Priorities (Electric Operations Bulletin 09-0005)
67	ES Spec 4720_R2.pdf	Specification No. 4720 for Transformer Assembly and Testing (Rev 2)

Attachment	File Name	Title
67 A	ES Spec 5160.pdf	Specification No. 5160 for Voltage Regulator, Distribution, Three Phase (Rev 00)
67B	ES Spec 5346_R1.pdf	Specification No. 5346 for Voltage Regulator, 60-115kV, Three Phase (Rev 1)
68	G13155 Attch1.pdf G13155.pdf	UO Guideline Design Criteria for Telecommunications Metallic Wire Circuits Serving Transmission and Distribution Stations, G13155, ISTS Standards S2004
69	Submittals for EPC Contracts_R6.pdf	Submittals for EPC Contracts after Award (Rev 6)
70	IB0179.pdf	Bulletin IB0179 Identification and Removal of Rockbestos Switch board Wire
70A	S3321.pdf WP3321-01.pdf WP3321-02.pdf WP3321-03.pdf WP3321-03 Attachment_1.pdf Asbestos Warning Label.pdf	Asbestos Operations and Maintenance Plan for Substations: Working on Elect Switchboard Panels Containing Asbestos & Conduit Transite Pipe Containing Asbestos
71	Water Quality Folder	Water Quality Construction BMP Manual

Attachment	File Name	Title
72	Test Document Folder	Requirements for Electrical Testing of Substation Equipment During Construction and Commissioning Tests. EPC Manual (For Testing) WP 3331-05 Testing and Commissioning Interface & Test Forms Matrix
73	067912_R1.pdf	Engineering Standards-Aluminum Bus Welding Requirements for Substations. Sh1 to 5 (Rev 1)
73A	WP3320-06.pdf F3320-06-1.doc	Work Procedure- Cutting and Welding Permits (Rev 00) Cutting and Welding Permit Form 3320-06
74	068666_R3.pdf	Electrical Design Standard Metering Assemblies (Rev 3)
75	G12002.pdf	UO Guideline G12002 Process of Electric Transmission Line Design and Construction Work (7/31/2008)
76	ES Spec 2722_R6.pdf	Specification No. 2722 for Circuit Breakers 12-21 kV Outdoor Type (Rev 6)
77	DC 073101.pdf	Design Criteria 073101 Site Preparation (Replaces DCM C-1.1) Rev 00

Attachment	File Name	Title
78	DC 073102.pdf	Substation Civil Design Criteria 073102 Steel Structures, Equipment Anchorage and Foundation (Replaces DCM C-1.2) (Rev 00)
79	DC 073103.pdf	Design Criteria 073103 Spill Prevention Control and Countermeasure (SPCC) Plans and Facility Improvements (Replaces DCM C1.3) (Rev 00)
80	EPC_As-Built.pdf	EPC As-built Process Flowchart
81	TD2345B-007.pdf	Protective Grounding Manual & Grounding in Substation by Contractors (Rev1)
82	Substation Equipment Disposal Folder	Substation Equipment Release and Disposition Process. Confined Space Work Procedures and Refurbishment Form for Transformers and Regulators.
83	DC 073120.pdf	Design Criteria 073120 Raceways- Conduit, Trench and Tray (Replaces E-1.10) Rev 00
84	DC 073104.pdf	Design Criteria 073104 Structural Design of Rigid Bus System (Replaces DCM C-1.4), Rev 00
85	391946_R4.pdf 391947_R4.pdf	CDS-General Notes & References Electrical Cable Trench Requirements Sections & Details (Rev 4)

Attachment	File Name	Title
86	DC 073158.pdf	Design Criteria 073158 Low Voltage Cable Systems (Replaces DCM E-5.8) Rev 00
86A	Control Cable Descriptions-600V.pdf Control Cable Descriptions-1000V.pdf Control Cable Descriptions-2000V.pdf	Descriptions of Material Codes for Control Cables-600V, 1000V & 2000V
86B	ES Spec 35_R2.pdf	Engg Specification No. 35 Specification for 115KV XLPE Cable & Accessories (Rev 2)
86C	ES Spec 36.pdf	Engg Specification No. 36 Specification for 230KV XLPE Cable & Accessories (Rev1)
87	ES Spec 5056_R2.pdf ES Spec 5057_R3.pdf	Technical Specification No. 5056 for Transformer, Transmission Single Phase (Rev 2) and Technical Specification No. 5057 for Transformer, Transmission, Three-Phase & Change Summary (Rev3)
87A	DC 073132.pdf	Design Criteria 073132 Transformers and Regulators, Power (Rev 00)
87 B	ES Spec 3125_R5.pdf	Technical Specification No. 3125Transformers Distribution Power (Rev 5)
88	ES Spec 82_R18.pdf	Engg Material Specification No. 82 for Single-Phase and Three-Phase Overhead Distribution Transformers, 500kVA and Smaller (Rev 18).
89	034963_R6.pdf	Distribution Transformer Requirements, Single-Phase, Over-head Type
90	066201_R14.pdf	Overhead Distribution transformer Application Guide (Rev 14)

Attachment	File Name	Title
91	DCM CST-04.pdf	Civil Design Criteria Memorandum For Steel Structures & Foundation on O/H Elect Transmission Line (Rev 2).
92	068177_R7.pdf	Transmission Line Design Criteria (Rev 7)
93	051742 sh1 to 33.tif	Civil Design Standard, Tubular Steel Poles
93A	375494_R5.pdf	Civil Design Standard Typical Details of Base Plates, Anchor Bolts & Augured Fdn For Pipe 6 Standard Columns (Rev 5)
94	MPAC Spec V5.pdf	Specification for MPAC Control Bldg. (Modular Protection Automation and Control (Spec 5651).(Rev 5)
94A	IRIG-B Cabling for MPAC.pdf	IRIG-B Time Signal Distrib Cabling Standard Practice for MPAC (Draft)
94B	4043866.pdf	Typical MPAC LAN Interconnection Diagram (Rev 2)
94C	MPAC Test Documents Folder	MPAC FQC, SAT & BAT Forms
94D	ES Spec 5655.pdf	Electric Standards Spec No.5655 Fire Protection Systems for Modular Substation Buildings (Rev 00)
95	4018144.tif	Elect Design Standard-Typical Arrangement & Installation of Batteries & Racks for Substation (Rev 1)
95A	366729.tif	Reference Drawing -Plans, Sections

Attachment	File Name	Title
		&Detail-Battery Building (Monta Vista Substation –Rev 1)
95B	397822_R1.pdf	Civil Design Standard Battery Building Foundation (Rev 1)
96	392693_R2.pdf	Requirements For Standard Metal Type Pre-Fabricated Substation Buildings (Rev 2)
96A	DC 073121.pdf	Design Criteria 073121 Control Building- General Design (Rev 00)
97	IB0223.pdf	Substation Engg Bulletin IB0223 Guide for Penetration Seals in Substations (11/29/04)
98	445471_R7.pdf 445472_R5.pdf 445473_R10.pdf 446368_R11.pdf 446369_R11.pdf	For Reference Only: Duplex Type Switchboard Construction Details Sh1 to 5
98A	447323_R12.pdf 447324_R9.pdf 447325_R10.pdf	For Reference Only: Simplex Type Switchboard Construction Details for Distribution Substations Sh 1 to 3
99	G15000.pdf Form F15000-1.doc Form F15000-2.doc Form 62-1174.doc	Utility Operations Guideline G15000 Contaminated Soil Management (11/20/03)
100	Substationmce.pdf	Substation Seismic Zone List

Attachment	File Name	Title
101	US_S3325.pdf WP 3325-01.pdf WP 3325-Attch 1 to 4.pdf SCH237 Attch_1 to 2.pdf FR Suppliers Catalog Folder	Utility Standard – S3325 Substation AF Hazards Control Program Work Procedure- Substation AF Hazards, AF Hazard Control Procedure Recommended FR Clothing Vendors
102	DC 073113.pdf	Design Criteria 073113 Ambient and Electrical Service Conditions (Rev 00)
103	DC 073119.pdf	Design Criteria 073119 Audible Noise (Rev 00)
104	DC 073134.pdf	Design Criteria 073134 Metal-Clad Switchgear (Rev 00)
104A	ES Spec 3555_R16.pdf	Technical Specification No. 3555 Switchgear 5-38kV (Rev 16)
105	DC 073139_R1.pdf	Design Criteria Memorandum 073139 Insulation Levels and Transient Protection(Rev 1)
106	DC 073140.pdf	Design Criteria 073140 Electric and Magnetic Fields (Rev 00)
107	Quality-Check-Off_R1.pdf	PG&E and Contractor's Quality Control Check-Off List
108	Geotechnical Investigation Request.pdf PG&E Geotech Standard.pdf	Geotechnical investigation request form and standard Geotech report
108A	Geotech Drill Cuttings Mgmt. pdf	Geotechnical Drill Cutting

Attachment	File Name	Title
	Chain of Custody Record.pdf RemoteWasteShippingPaper.pdf	Management & Forms
109	Civil Construction Quality Assurance Guidelines_R0.pdf	PG&E Construction Quality Assurance Requirements
110	CSD Area Map.pdf	Corporate Security Department Area Map
111	Substation Asset Forms Folder	Substation Asset Equipment Forms
112	S2054_VSAT.pdf	IT Standard S2054 VSAT Satellite
113	Spec No.5217_CivilConstruction.pdf	Specification 5217 Module 4 Civil Construction

End of Specific Conditions



**SPECIFIC CONDITIONS FOR OVERHEAD, UNDERGROUND & CIVIL
CONSTRUCTION**

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Attachment 8B MSA No. 4400010156 Elect Dist. Specification
6603 Ver. 2.0
Electric Overhead, Underground, and Civil Construction
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- 1.0 DEFINITIONS:** In addition to the definitions below, the definitions for the defined terms contained herein are listed in Paragraph 1.0 of the Construction General Conditions.
- 1.1 **CONSTRUCTION DRAWINGS:** A set of drawings establishing typical installation requirements for specific work and may be an attachment to a CWA, Job Package, or long form contract.
 - 1.2 **DAILY INSPECTION LOG:** A document maintained by PG&E Inspector to record daily activities performed on the job by Contractor.
 - 1.3 **EXCAVATION** (per California Government Code 4216(b)): Any operation in which earth, rock, or other material in the ground is moved, removed, or otherwise displaced by means of tools, equipment, or explosives in any of the following ways: grading, trenching, digging, ditching, drilling, auguring, tunneling, scraping, cable or pipe plowing and driving, or any other way.
 - 1.4 **INTERNATIONAL BROTHERHOOD OF ELECTRICAL WORKERS or IBEW REPRESENTED WORK:** Work identified by Pacific Gas and Electric Company (PG&E) as work normally performed by personnel represented by the IBEW union.
 - 1.5 **JOB PACKAGE:** Encapsulated document which contains, but not limited to, crew instructions, drawings, electric corrections (EC) notifications, permits and other relevant documents detailing the Work that the Contractor shall be responsible to complete.
 - 1.6 **JOINT PARTIES:** Other parties who may have an interest in the Work but are not bound to the Parties contractually.
 - 1.7 **JOINT POLES:** Poles owned jointly by PG&E and other utilities.
 - 1.8 **PG&E REPRESENTATIVE or PG&E INSPECTOR or PG&E Contract Management Department:** PG&E's employee(s) who represents PG&E's interest and have oversight, inspection and coordination responsibilities for all assigned Work described in each CWA.
 - 1.9 **PG&E SALVAGE MATERIAL:** Materials and equipment removed while performing Work from existing PG&E Facilities that can be reused by PG&E or sold to a recycling facility.
 - 1.10 **RUBBER GLOVING:** Means the use of insulated rubber gloves, tested to ASTM standards and rated for the voltages involved, to perform energized work at voltages greater than 7,500 volts phase-to-phase up to 21,000 volts phase-to-phase. In addition, all applicable Title 8 rubber glove rules for lower voltages, 0 to 7500 volts shall be followed.
 - 1.11 **SUBSURFACE ENCLOSURES:** Underground enclosures that are made of either concrete or fiberglass and are used to house meters, wire splices, switches, transformers or other electric equipment. Other names include, but are not limited to, boxes, manholes, splice boxes, enclosures, vaults or utility boxes.
 - 1.12 **WORK PROCEDURE ERROR:** An event that due to negligence by the Contractor through poor workmanship, human error or non-adherence to work procedures, causes an unplanned electrical outage to PG&E customers or damage to PG&E facilities, electric or gas.
- 2.0 PG&E Technical Information Library (TIL)**
- 2.1 PG&E Standards, Bulletins, Policies and Procedures located in the TIL may be accessed through the following methods:

- 2.1.1 Contractor, once enrolled will have access to these documents through PG&E's Unifier Application.
- 2.1.2 In addition, the Contractor using a PG&E computer and PG&E login and password with access to the PG&E Technical Information Library (TIL), which may contain documents not available in Unifier, the Contractor shall always check this web page (<http://www.pge.com/greenbook/>) for the latest versions of the engineering documents.
- 2.1.3 Request hard copies or electronic copies from a PG&E Representative.
- 2.1.4 All PG&E documents in this Contract are incorporated by reference. PG&E may provide updates to these documents from time-to-time, but it remains the responsibility of the Contractor to obtain, review and comply with the latest version of each document. If Contractor encounters a problem accessing a hyperlink document, the Contractor shall notify a PG&E Representative.

3.0 GENERAL AND PURPOSE

PURPOSE: The Specific Conditions related to excavating, installing, replacing, modifying, undergrounding and upgrading of overhead and underground electric facilities and underground conduit performed on behalf of PG&E and/or Joint Parties.

- 3.1 All Work hereunder shall be performed in accordance to the industry standards and requirements including, but is not limited to, the California Public Utility Commission (CPUC) General Order Nos. 95 (GO95) and 128 (GO128); Electric Rule 20, Overhead to Underground Conversions of Electric Facilities as filed with the CPUC; 49 CFR 192 and 49 CFR 195; environmental and safety issues; and the most current version of the following PG&E Manuals, Standards, Procedures, and Environmental requirements hereto incorporated into this Contract by reference:
 - PG&E Electric Overhead Construction Manual (TD-2501M)
 - PG&E Electric Underground Construction Manual (TD-2502M)
 - PG&E Electric and Gas Service Requirements aka Green Book (TD-7001M)
 - PG&E Horizontal Direction Drilling Manual (S4135)
 - PG&E Utility Standard: Gold Shovel Standard Damage Prevention Administration (TD-5805P-02)
 - PG&E Construction Long Form General Conditions
 - Supplier Quality Assurance Quality Management Manual (SCM-2100M)
 - PG&E's Utility Standard: Fire Danger Precautions in Hazardous Fire Areas (TD-1464S)
 - PG&E Utility Standard: Notice to Customers (S1418)
 - Application of Compression and Automatic Splices for Distribution Conductors (TD-022487B-001)
 - PG&E Design Requirements for Underground Primary Cable (TD-038193B-0000)
 - PG&E Electric Design Manual (TD-9001M)
 - PG&E Utility Work Procedure: Excavation Procedure for Damage Prevention (TD-4412P-05). Section 8 is deleted in its entirety and is replaced with the procedure as set forth in Utility Bulletin: Cross Bore Preventive Requirements (TD-4412B-012)
 - Environmental Requirements:
 - 5 Minute Meeting – Environmental Release to Construct (ERTC) Package Changes



- Electric Distribution General Best Management Practice (BMP) ERTC Attachment Guide Package Sections 1 to 5
 - Electric Distribution Frequently Used Storm Water Activity Specific Erosion and Sediment Control Plan (A-ESCPs) and BMPs ERTC Attachment Guide Package Sections 6 and 7
 - Electric Distribution Infrequently Used Storm Water AESCPs and BMPs ERTC Attachment Guide Package Section 8
- 3.1.1 Contractor warrants to PG&E that the Work shall be performed with the degree of skill and care that is required by the highest good and sound professional procedures and practices, and in conformance with the generally accepted industry standards prevailing at the time the Work is performed so as to ensure that the Work performed is correct and appropriate for the purposes intended by PG&E Work requested shall, at PG&E's option will be based on Contract unit prices, lump sum (if PG&E decides to competitively bid) or hourly rate (Time and Equipment or T&E) basis. Pricing under each of these scenarios are further detailed in General Conditions.
- 3.2 AUTHORIZING WORK: Any performance of Work by Contractor shall be authorized by issuance of a CWA or Long Form Contract. A CWA may be issued at any time during the term of this Contract. The specific Scope of Work will be explicitly described in detail in the CWA. Contractor agrees to perform the Work in accordance with the terms and conditions set forth in the Contract, and any CWA that PG&E may issue thereunder and shall be signed by the Parties prior to commencement of Work. Each CWA may provide at a minimum, the following information:
- 3.2.1 Detailed description and location of the Work PG&E is authorizing Contractor to perform:
- The required deliverables and details that must be included in the deliverables;
 - PG&E Representative in charge of the Work and invoicing instructions;
 - Deliverable due dates and project milestone dates;
 - Cost for the Work.
- 3.3 CWA ACCEPTANCE: Upon receipt of the CWA, Contractor shall review the CWA and verify that the terms of the CWA are accurate and complete and shall determine whether Contractor has the capacity to perform the Work specified in compliance with all the requirements of the Contract and those specified in the CWA. Contractor shall indicate its acceptance of a CWA by having an authorized representative sign the CWA and forward the signed CWA to PG&E. If Contractor cannot accept the CWA, Contractor shall immediately notify PG&E.
- 3.4 CWA MODIFICATION: If the PG&E Representative requests Contractor perform Work that Contractor believes is not included in the Work scope of an approved CWA, Contractor shall immediately notify PG&E of that belief.
- 3.4.0 PG&E and Contractor will negotiate and approve any necessary changes to a CWA by issuance of a Change Order. Changes to an executed CWA shall be prepared and approved in the same manner as an original CWA, with the Parties signing the Change Order.
- 3.4.1 Contractor agrees that no verbal statement or direction shall in any way modify or affect the terms of a CWA.
- 3.5 CWA CHANGE ORDER PROCESS: For any changes to the scope of the Work to be performed which requires a modification to the CWA amount, Contractor shall follow the Field Authorization Process as outlined in Attachment B, Field Authorization Instructions and Forms.
- 3.5.0 Approved Field Authorization Form shall be submitted to a PG&E Representative.



- 3.5.1 All changes must be pre-approved by the PG&E Representative before the commencement of work.

For Change Orders other than for scope of work changes, the Contractor shall notify PG&E weekly throughout a project of their pending submittal. Any change order requests not submitted in a timely manner (within thirty (30) days of the completion of a project) will not be accepted.

- 3.5.2 The checkbook forecast shall consist of costs that the Contractor's project will invoice during the month. The first checkbook forecast is collected during the first week of the month and will be included in the performance Scorecard. The second checkbook forecast is collected towards the middle of the month to provide a more accurate forecast to PG&E. Actual costs that have already invoiced during the month should be included in the second checkbook forecast.

- 3.5.3 CWAs that have completion dates beyond the completion date of the Contract shall continue to be governed by the terms and conditions of the Contract until said CWA's completion date.

- 3.6 **CONTROLLING ORDER:** All Work shall be performed in accordance with the terms and conditions set forth in this Contract, including the specific terms set forth in the applicable CWA. Should a conflict exist between the Construction General Conditions and the Specific Conditions, the Specific Conditions shall control. **THIS CONTRACT MAY BE MODIFIED ONLY BY A CONTRACT CHANGE ORDER SIGNED BY THE AUTHORIZED REPRESENTATIVES OF BOTH PARTIES, AND SHALL NOT BE MODIFIED, IN WHOLE OR IN PART, BY ANY CWA.** Should a conflict exist between the Contract and applicable federal, state, or local law, rule, regulation, order or code (collectively, "Laws"), the applicable Law shall control. Varying degrees of stringency between the Construction General Conditions, Specific Conditions, and Laws are not deemed conflicts, and the most stringent requirement shall control.

4.0 SCOPE OF WORK

- 4.1 **OUTLINE OF WORK:** The Work may include, but is not limited to, furnishing all labor, transportation to work site, material as required (unless otherwise stated), equipment, tools, supplies and supervision and project management to provide a fully operational underground and overhead electric system and underground conduit system.

- 4.1.0 All Work shall be performed on an as-needed basis as requested by PG&E in accordance with the Contract.

- 4.1.1 All Work shall be performed in a manner that will minimize the number and duration of service disruptions to PG&E customers.

- 4.1.2 **Energized Work:** Performance of work in the energized mode for overhead electric primary distribution work is required. Transformer or secondary level outages to customers are acceptable, when keeping the primary energized. It is recognized that some work will require primary clearances and customer outages such as underground projects and for overhead safety or other issues. For these outages, the contractor shall minimize the number of customers affected through the installation of primary and secondary line openers, temporary disconnects, opening jumpers, breaking T-bodies or placing cables on insulated standoff, which will be utilized to establish clearance points. In addition to the utilization of the aforementioned items, the contractor may be required to perform simple switching operations including opening/closing cutouts and switches.



- 4.1.2.1 For all situations where the contractor deems a clearance or a customer service disruption is required, advance approval shall be obtained from the PG&E Contract and Construction Management (C&CM) department prior to notification of the customers.
- 4.1.2.2 **Planned Outage Duration:** For all planned outages, both overhead and underground, that are approved PG&E requires the duration of the outage be contained to a minimum and that the Contractor start at the scheduled time and completes the Work on or before the scheduled time committed to PG&E's customers.
- 4.1.2.3 **Pre-checking of Work and Pre-Work for Planned Outages:** The contractor shall be responsible to pre check all work locations pertaining to the planned outages and to perform any pre work which is required leading up to the clearance or customer shutdown to ensure Contractor is able to meet the planned outage timelines. The pre-work expectation shall not be limited to the day of the shutdown, but includes the preceding days, based on the amount of work required to prepare for the planned outage date. This expectation includes civil and both the electric overhead and underground work.

4.2 PREPRATORY PLANNING

- 4.2.0 Contractor shall inspect the Work site and undertake and obtain any and all necessary field measurements to be familiar with the nature and location of the Work prior to commencing the Work. Contractor shall review the plans or other related documents pertaining to the Work which are submitted by PG&E Representative.
- 4.2.1 Contractor shall notify PG&E Representative in writing of any conditions detrimental to proper and timely completion of Work, errors, inadequacies or inconsistencies in the plans and related documents and potential hazardous situations. Contractor shall request additional clarification or correction of unsatisfactory conditions. If Contractor fails to notify a PG&E Representative and still proceeds with the Work, Contractor shall assume all responsibility for errors, inadequacies, inconsistencies, or defects and hazard-related conditions.
- 4.2.2 Prior to performance of Work, Contractor, when applicable, shall notify jurisdictional agencies and general public of impending construction that may impact power and other utility supply, noise, traffic and safety.

4.3 LOCATING UNDERGROUND FACILITIES

- 4.3.0 Work may require Contractor to perform the Work over, under, or adjacent to PG&E's existing gas and electric facilities and other underground facilities. Contractor must locate, prospect and expose all underground facilities that could be subject to damage. Contractor shall exercise caution to avoid damage to or disturbance of these facilities and shall be held liable for any damages, whether direct, indirect or consequential, resulting from Contractor's operation, in accordance with the Contract. Should damage occur, Contractor shall immediately notify both the owner of the facility and PG&E of the damage done to the facility and shall arrange for repair of the damage. Contractor shall make every effort to minimize consequential damage resulting from the construction specified herein. **CONTRACTOR MUST PROSPECT AND EXPOSE ALL**



EXISTING SUBSTRUCTURES PRIOR TO TRENCHING AND ADHERE TO ALL USA GUIDELINES.

- 4.3.1 Contractor shall notify "Underground Service Alert" (USA) 48 hours prior to any excavating or installing anchors. Telephone number: 811. Contractor must maintain USA marking on sections of jobs for which construction activities are in progress. Contractor assumes sole responsibility for any damages to facilities during performance of Work under this Contract, in accordance with the terms of this Contract. A USA ticket is valid for twenty eight (28) calendar days.
- 4.3.2 Prior to beginning Work Contractor shall notify all utility companies, requesting that they locate and mark their existing underground facilities and to maintain markings when construction activities continue beyond twenty eight (28) calendar days.
- 4.3.3 Since USA does not contact private property owners, Contractor shall contact private property owners prior to digging holes or installing anchors on private property to verify the location of privately-owned underground facilities such as gas lines, water lines, etc. and to coordinate the Work with the property owners.
 - 4.3.3.1 If it becomes necessary for PG&E to relocate its existing underground facilities in order for the Contractor to install conduit and vaults, PG&E will compensate Contractor for any related delays, mobilizations, demobilizations or any other Contractor incurred costs resulting from the work at negotiated labor and equipment rates.
 - 4.3.3.2 Prior to performing any saw cutting or excavation Contractor shall produce a video of the existing sidewalks and road surfaces and provide the video to PG&E. The video shall show all existing conditions, including surface defects, referenced from the nearest building address.
 - 4.3.3.3 An operator qualified (with qualifications approved by PG&E) as a gas stand-by person must be present when excavating within 5 feet of any critical gas facility or gas pipeline operating at a pressure greater than 60 psig. For PG&E facilities, the Contractor is responsible for notifying the PG&E Contract Management Department Representative a minimum of five (5) days in advance when any excavating situation as specified in this section so that notification to PG&E gas personnel can be made. For third party facilities, the Contractor is responsible for making the notifications.
- 4.3.4 Contractor shall not perform or provide the following:
 - 4.3.4.1 Contractor shall not make any alteration or addition to any existing PG&E facility, equipment or fixture not outlined in CWA without prior written approval from PG&E Representative.
 - 4.3.4.2 Furnish materials that are to be made available by PG&E as specified in Attachments F and G unless otherwise stated in writing.
 - 4.3.4.3 Backfill, cover or conceal Work until inspection and testing for acceptance has been performed by PG&E Representative to its satisfaction.



- 4.4 **ADDITIONAL SERVICES:** Additional services are unforeseen Work that were not originally included in a CWA. If approved by PG&E, Contractor shall be compensated for such additional Work in accordance with the pricing attached herein.
- 4.4.0 Contractor shall not make any claim for additional Work when supplementary or revised Construction Drawings were provided to Contractor to clarify detail or information or to refine requirements of a CWA. Minor changes shall not be construed as justifiable claim for reimbursement.
- 4.4.1 Contractor shall not perform any additional Work prior to receiving written authorization from PG&E through an amended CWA signed by both parties. Contractor agrees that all costs for any additional Work performed by Contractor without PG&E's advanced written approval shall be at Contractor's sole risk.
- 4.5 **REPORTING:** Unless otherwise specified in writing, Contractor shall on a monthly basis or coinciding with the invoicing period for the CWA, whichever is more often, report to the PG&E Representative for the CWA the following information at a minimum with regard to the status of Work for the CWA.
- 4.5.0 Activities performed by Contractor during the reporting period, including significant progress, set-backs or outstanding issues.
- 4.5.1 Changes, additions or decreases to the Work performed by Contractor, as assigned in the CWA, including out-of-scope Work that may have been performed by Contractor.
- 4.5.2 Budget expenditures for the reporting period and to-date for the CWA, as compared to progress, including any projected budget issues or potential changes to assumptions made by Contractor in estimating the Work.
- 4.5.3 Review of the schedule for the Work, as agreed by Contractor and PG&E and compared to the actual progress by Contractor, including any deviations from the agreed schedule and reason for such deviations.
- 4.5.4 Corrective actions or modifications proposed by Contractor which should be considered, reviewed or approved by PG&E.
- 4.6 **NOTIFICATIONS:** Contractor shall immediately notify PG&E regarding any problems that may significantly affect performance of Work by Contractor.
- 4.6.0 Contractor shall report issues to the PG&E Representative. For example, problems may include but are not limited to: significant changes, additions or decreases, to the Work including out-of-scope Work, which may significantly affect the cost, schedule, quality or other factors; delay in submittal of a deliverable to PG&E; Contractor non-compliance with any of the Contract terms; and, other circumstances which may warrant immediate notification to PG&E.
- 4.6.1 Following such notification, Contractor shall respond to PG&E requests for additional information within three business days of such request, unless otherwise specified by PG&E.
- 4.7 **DELIVERABLES AND ACCEPTANCE:** Deliverables provided by Contractor shall be subject to PG&E review, approval and acceptance.
- 4.7.0 Unless otherwise specified in a CWA, Contractor shall submit preliminary deliverables to PG&E for review and comment. Contractor shall incorporate any



PG&E comments to the satisfaction of PG&E prior to submittal of the final deliverables, as agreed by Contractor and PG&E.

- 4.7.1 ACCEPTANCE OF ANY DELIVERABLE PROVIDED BY CONTRACTOR UNDER THIS CONTRACT SHALL IN NO WAY LIMIT PG&E'S RIGHTS UNDER THIS CONTRACT.

4.8 WORK TO BE PERFORMED BY PG&E

- 4.8.0 PG&E will perform all design engineering, provide material specifications and specify test procedures to be employed by the Contractor for the Work unless otherwise noted in the CWA.

- 4.8.1 PG&E will acquire any land and land rights necessary for the operation and maintenance of the permanent facilities to be installed.

- 4.8.2 PG&E will acquire and keep current those permits or licenses that can be granted only to PG&E (e.g. all right-of-way easements and permits, railroad and highway crossing permits, other easements, permits and licenses for pipeline crossings and street opening permit).

- 4.8.3 The PG&E Representative will schedule and conduct pre-construction meetings (job walks) at the jobsites. The pre-construction meetings will include the Contractor and the PG&E Representative.

- 4.8.4 PG&E will regularly schedule status meetings for all Work awarded under this Contract to review ongoing work.

- 4.8.5 PG&E will schedule a monthly meeting between the Contractor and contract management leadership to review the contractor scorecard, safety incidents and other pertinent issues.

- 4.8.6 PG&E will inspect Contractor's Work for proper installation and satisfactory workmanship.

- 4.8.7 PG&E will conduct quality audits on a percentage of selected jobs in accordance with Supplier Quality Assurance Quality Management Manual (SCM-2100M).

4.9 Contractor, Consultant and Supplier Code of Conduct

- 4.9.0 Contractor shall comply with PG&E's Contractor, Consultant and Supplier Code of Conduct as described in Paragraph 30.3 Code of Conduct, Business Ethics, and Availability of Information of the General Conditions of the Contract.

5.0 SCHEDULE OF CONSTRUCTION

5.1 Project Baseline Construction Schedule

- 5.1.0 Activities: All Contractors assigned work shall be shown in a logical work sequence that indicate the estimated time duration, sequence requirements. Provide coding of each activity to show Phase, Area, Location, and Responsibility for tracking purposes.

- 5.1.1 Break up the Work schedule into activities of durations of approximately five (5) days or less each, except for non-field Contract and activities as otherwise deemed acceptable by PG&E.